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PART 1.

Event and Comment.

Fodder Conservation—A Practical Suggestion.

ME. WALKER in his new year message to the farmers of Queensland has made a very practical suggestion for the conservation of fodder, which applies particularly to our dairying districts. Early, abundant and widely-distributed rains have already assured bountiful prospects. The 1930-31 season was a peak period in production; and with an expanding industry, due to improved farming methods, the subdivision of grazing areas, and the opening up of Crown lands, a greatly increased output of dairy products is anticipated. To ensure the progress and prosperity associated with fertile soils and generous summer rainfall, it is essential that suitable provision be made for ample fodder conservation so that a high level of production may be maintained throughout the drier and colder months.

The provision of suitable food for stock is a prime factor in dairy farming economy, and is practised by successful producers who realise that seasonal shortage of pasture and cultivated crops must be met by adequate fodder reserves. The conservation of suitable fodder crops, such as lucerne, Japanese millet, Sudan grass, oats, wheat, and barley in the form of hay; and maize, wheat, oats, and barley as grain, is a wise and necessary provision against the inevitable lean year. A large variety of summer-growing crops are suitable for conservation in the form of silage. Maize, sorghums, millets, and other heavily productive crops can be conserved in the form of succulent, palatable fodder as silage by the inexpensive stack method. This method of conservation requires a small initial outlay of capital; the process is simple and has many economical features that appeal to stock owners.

To secure the benefits of the present favourable summer conditions, preparation should be made immediately for the planting of crops for conservation in the form of silage, and so provide a succulent roughage for the winter and early spring.

The advantages of fodder storage in the form of silage may be summarised as follows:—

1. The carrying capacity of the farm is increased.
2. The annual production of the dairy herd, by providing a succulent fodder when pasturage is dry and green fodder crops are not available, is increased.
3. Compared with dry fodder, conversion into silage ensures a saving of from 25 to 40 per cent. of the feeding value of the crop ensiled.
4. A stack of silage on a dairy farm is an insurance against periodical dry spells; and there is a place for some form of silage on every dairy farm.

Dairy farmers should grasp the opportunity now at hand and take advantage of the bountiful season ensured by the recent rains, and plant at least 10 acres of fodder crops for silage purposes without delay. The Department of Agriculture and Stock will show how to make a stack and give all the additional advice and guidance necessary.

Pig Breeding Experiments at Gatton College.

PIG breeding experiments initiated at the Queensland Agricultural High School and College at Gatton three years ago have now reached a stage when the controlling committee feel that a progress report should be published. The experiments are under the control of a sub-committee representative of the Queensland Pig Industry Committee, the Department of Agriculture and Stock, and the Department of Public Instruction, the actual control at the college being in the hands of the Principal and his staff. The object of the experiments is to ascertain by test the breed or cross which combines best the attributes of the commercial pig.

In the initial stages, the necessary finance was provided by the several bacon factories, the Department of Agriculture and Stock, and the Department of Public Instruction, while a number of stud pig breeders agreed to sell to the committee, at reduced prices, such breeding stock as were required for the tests; the college stud provided the balance. At the commencement of the test, the objective was the collection of data bearing on prolificacy, rate of growth, suitability for market requirements, and economy of production. Figures bearing on economy of production have not yet been made available, but other data have been collected and will finally be checked over by the Commonwealth Biometrician, an officer who specialises in the analysis of data of this description for the Commonwealth and State Governments.

Up till the end of November, 1931, 583 bacon pigs were marketed, all of which were farrowed, reared, and fattened at the College piggery. When the pigs reached bacon weights they were forwarded to factories nominated by the Queensland Pig Industry Committee. These pigs were all weighed prior to despatch after fasting for twelve hours; they were weighed again immediately before slaughter, and again after dressing, and, finally, after curing. As soon after slaughter as convenient, the carcasses were measured and classed by a committee, consisting of the college representative and the works manager from each factory. Similarly, the cured products were graded by this committee, with the addition of a sales representative from each factory. The first grading took into consideration shape, condition, and quality.

The experiments have been taken through four complete series, and, as stated, 583 bacon pigs had been marketed up till the end of November, 1931.

Progress and final results will be published when complete information is available.

Maize as a Ration for Pigs.

AFURTHER series of experiments has been initiated at the special request of the Queensland Pig Industry Committee, these being considered necessary by reason of the fact that, during the months of the year when maize is plentiful and skim milk scarce, there is an increase in the supply of over-fat pigs to the bacon factories.

The experiments aim at ascertaining, by feeding tests:—

- (a) The minimum amount of skim milk required for addition to a maize ration;
- (b) Value and cost of substitute for skim milk as an adjunct to a maize ration;
- (c) Value of milk substitute, plus lucerne chaff as an adjunct to a maize ration.

Maize is to be used as the basic ration throughout the test, the object being to ascertain whether pigs in correct condition, not over-fat, can be produced along the lines indicated. It is hoped these tests will be of added value, especially as the area under maize in Queensland is capable of considerable expansion, while the pig industry is still in its infancy and has wonderful possibilities, provided costs of production of suitable quality stock can be kept down low enough to enable overseas and local markets to be built up to their maximum strength.

Mineral Ration for Dairy Cows.

THE inclusion of minerals in the ration of the modern dairy cow is a vital factor in the maintenance of the health, production, and the proper performance of her natural functions. The two minerals most likely to be deficient in the food of the dairy cow are calcium (lime) and phosphorus. Minerals absorbed go to build up bone, maintain the balance of salts in the blood, provide for the supply of minerals (ash) contained in the milk, and provide for the development of the fetus and the birth of the calf. With increasing standards of milk production, apart from other bodily needs of mineral, it is essential that the ration available for the dairy cow should contain the required quantity of essential mineral elements.

An adequate mineral content is generally provided when a variety of feeds and legume hay (lucerne or peas) is fed, but heavy-producing cows frequently require a supplementary mineral ration before calving and during periods of high production. Notwithstanding an ample supply of other food material, if there is a shortage in one of the essential mineral constituents over a period the health of the animal will be affected and production eventually decrease. Heavy-producing cows require relatively larger supplies of calcium and phosphorus. A gallon of milk contains approximately $\frac{1}{2}$ oz. of lime and $\frac{1}{2}$ oz. of phosphoric acid. A cow giving 4 gallons of milk is subjected a daily drain of 1 oz. of lime and $\frac{1}{2}$ oz. of phosphoric acid. To ensure that a cow can produce to her full capacity and remain in normal health an adequate mineral ration must be fed.

In certain sections of the State, chiefly in the coastal areas, the soil lacks an adequate supply of phosphoric acid, and feed produced on it is deficient in the mineral requirements of the dairy cow. Dairy cows pastured on this class of country and fed on the products of a deficient soil show a desire to eat foreign materials, such as pieces of paper, rags, bark of trees, and bones. As the disease advances the affected animals become stiff in the joints, the back humps, hair stands up, the eyes become dull, and the appetite decreases. In the more advanced stages the joints creak when the animal moves. Malnutrition, due to phosphoric deficiency, results in a weakening of the constitution, susceptibility to certain diseases, checks development, and interferes with the natural functions of the animal.

The effect of mineral deficiency is not so apparent as is the incidence of a shortage of flesh-forming or energy-giving nutrients. In the latter case the animal loses flesh through a want of proteins and carbohydrates. The gradual depletion of the mineral stores of the body of the animal is not apparent from an outward inspection, and many dairy animals are starving for a mineral ration unaware to the owner. The dairy cow requires a daily ration of salt (sodium chloride). The sodium is required to maintain the supply in the blood while the chlorine furnishes an element of the hydrochloric acid found in the gastric juice—the digestive agent of the protein consumed. A cow should be allowed at least 1 oz. of salt a day. Rock or coarse salt should be made available to the dairy herd. A number of other mineral elements are found in the animal body. One of them, iodine, is of special importance, not only as a safeguard against goitre, but because of the fact that the animal cannot completely absorb the calcium phosphorus and iron to meet its requirements except in conjunction with the small quantities of iodine. The normal functioning of the glands of the body which deal with nutrition and health, as well as those which are associated with the function of reproduction, appears to depend on the presence of iodine in small quantities. The importance of this element has received the attention of research workers on animal nutrition, and many stock owners take the precaution of adding a small quantity of potassium iodide to the mixture of minerals provided for the stock. Two ounces of potassium iodide added to 1 cwt. of lick mixture will remove the risk of any deficiency. The lick mixture recommended by the Agricultural Chemist is one part of common salt to two parts of finely ground Nauru or Ocean Island phosphate, or sterilised bone meal. This may be fed at the rate of, say, 2 oz. a day, but it is preferable to place the lick in a suitable position and allow the animals to partake of it as they require. Feeding for profit means feeding a balanced dairy ration to the full capacity of the animal to enable her to respond to it by increased yields. Such is the characteristic of the profitable dairy cow, the foundation on which is built the wealth of the dairying industry.

The Minister's New Year Message.

TO THE FARMERS OF QUEENSLAND.

Department of Agriculture and Stock,
Brisbane, 31st December, 1931.

WE all owe something to the country which has given us what we have and made us what we are. We all owe Australia service—In these days of difficulty, the best that we can give in ungrudging and unstinted measure. During the year now ending no service has been more useful to the Commonwealth, and none more truly glorious than that rendered by our primary producers. It was they who furrowed deeply the soil of industry to win the new wealth so greatly needed. In the coming year that great national service will assuredly be continued.



In Queensland, generous and widely distributed rains have given us the certainty of another bountiful season. It therefore behoves us to take full advantage of Nature's prodigality in this time of plenty and make wise provision against a period of scarcity. My message to you, therefore, is to complete your plans as soon as possible for fodder conservation on a scale commensurate with your resources, and so ensure a continuance of that production which is so essential to Australia's economic existence.

In the coming year I wish you success in all your enterprises, a continuance of happiness in your homes, and a fair share in the greater national prosperity which, I believe, is now returning.

HARRY F. WALKER,
Secretary for Agriculture and Stock.

QUEENSLAND SUGAR INDUSTRY

By H. T. EASTERBY, Director, Bureau of Sugar Experiment Stations.

PART XXII.

(f) Sugar Prices, Etc.—(continued).

ABOUT the time of the outbreak of the Great War a critical period set in for the sugar industry in Queensland. Since Federation the costs of labour had been continually rising. In 1914 the awards made under "*The Industrial Peace Act of 1912*" had the effect of again materially increasing the cost of producing sugar, while nothing in the shape of increased protection had been given by the Federal Government. Tariff matters had been placed in the hands of an "Interstate Commission," which, incidentally, did not reign very long. When the sugar interests approached this body for consideration the Board decided to postpone the matter on the grounds that the war in Europe was sufficient protection in itself, and further said "the sugar producers would have the market to themselves for the next two years." This, while true, was poor consolation to the Australian sugar-growers at a time when sugar values in all parts of the world but Australia were rising by leaps and bounds. As a matter of fact the Australian price of sugar towards the end of 1914 was £1 per ton less than it was at the same time the previous year. No benefit had therefore come to the sugar-producer from the war or from the fact that he did have the Australian market to himself.

The price of sugar in 1914 was £14 15s. 6d. per ton for the reason that, taking advantage of a temporary fall in the price of sugar, price-fixing boards appointed by the Governments of New South Wales and Victoria, where the greater part of the sugar is consumed, fixed the wholesale selling price of refined sugar at £21 per ton, regardless of the fact that this was much lower than the average price of the previous three years. The Annual Report of the Bureau of Sugar Experiment Stations for 1915 made the following comment on this:—

"It was found that the Queensland production of sugar, instead of being stimulated and encouraged, was being retarded by the unduly low price fixed by the Southern Control of Prices Board. This led in many cases to mills making an absolute loss on the season's operations, and forbade the farmer obtaining that increase in payment for his cane to which he was justly entitled in order to meet the higher cost of production and the increase in the cost of living. This happened at a time when the price of sugar had been materially enhanced in the other sugar-producing countries, particularly in those employing cheap coloured labour. It was a position directly antagonistic to the white labour ideals of this country and the national view of settling the northern littoral by means of the sugar industry for defence purposes."

It was only by putting into operation "*The Sugar Acquisition Act of 1915*" that the Government was able, with the assistance of the Commonwealth, to acquire the whole crop at a price enabling a better return than was possible under the price fixed by the Southern Board.

In spite of this, however, sugar manufacture during the War period and for a couple of years thereafter was a more or less precarious business, particularly in the Mackay district. Evidence given in Mackay before the Second Commonwealth Royal Commission on the

Sugar Industry was to the effect that there was a very great danger of the industry collapsing in Mackay unless something were done. Not a Central Mill in Mackay at that time could get consideration from the banks unless the directors pledged their own securities and gave joint and several guarantees for advances. No mill could attempt to increase its supply of cane by extending its tramways, because it was impossible to secure the money to do so. The price of raw sugars for the years 1915 and 1916 was £18 per ton; for 1917 to 1919 inclusive it was £21. What with the high cost of labour and the price paid for cane, the mills had a difficult time from 1914 to 1920.

Fortunately for the industry better times were at hand. The continual upward tendency of the world's market price for sugar became so great that it was generally recognised that the sugar-growers of Australia were being treated unfairly, and it was decided that a deputation should wait upon the Prime Minister of the Federal Government and request that the price per ton of raw sugar should be increased from £21 to £30 6s. 8d., and that an agreement to that effect should be made for a period of not less than three years. This deputation met in Melbourne and Sydney with representatives of the Queensland and Federal Governments and other branches of the industry, and its request was finally acceded to under certain conditions, the rise in price being apportioned as follows:—£5 6s. 8d. to the sugar-growers and £4 to the sugar-millers. This price was much fairer, and immediately gave an impetus to the production for the next season.

The more favourable rates for sugar did not come any too soon, as the price of all commodities which the sugar-grower used had increased by leaps and bounds. It had been hoped after the conclusion of the war that prices would drop, but this did not prove to be the case.

Compared with the prices that had been obtained for sugar in outside countries during the two or three previous years, even the price of £30 6s. 8d. was low; £90 per ton had been recently paid for Mauritius sugar by Great Britain. The Queensland grower, as had been frequently pointed out, never demanded the world's parity.

This rise in price, although only continued for three years, was the salvation of many of the mills, and enabled them to finance operations and instal new machinery and tramways that were urgently needed. From 1900 to 1920 the average production of sugar had been 164,339 tons, but farmers now began to put more land under cane and the mills to increase their capacities to deal with the larger crops offering. The increase in cane crops from 1921 to 1930, and the sugar manufactured can be seen from the following table:—

Year.	Tons of Cane Crushed.	Tons of Sugar Made.	Tons of Cane per Ton of Sugar.
1921	2,287,416	282,198	8·11
1922	2,167,990	287,785	7·53
1923	2,045,808	269,175	7·60
1924	3,171,341	409,136	7·75
1925	3,668,252	485,585	7·55
1926	2,952,662	389,272	7·52
1927	3,555,827	485,745	7·32
1928	3,736,311	520,620	7·18
1929	3,581,265	518,516	6·91
1930	3,528,660	516,783	6·83

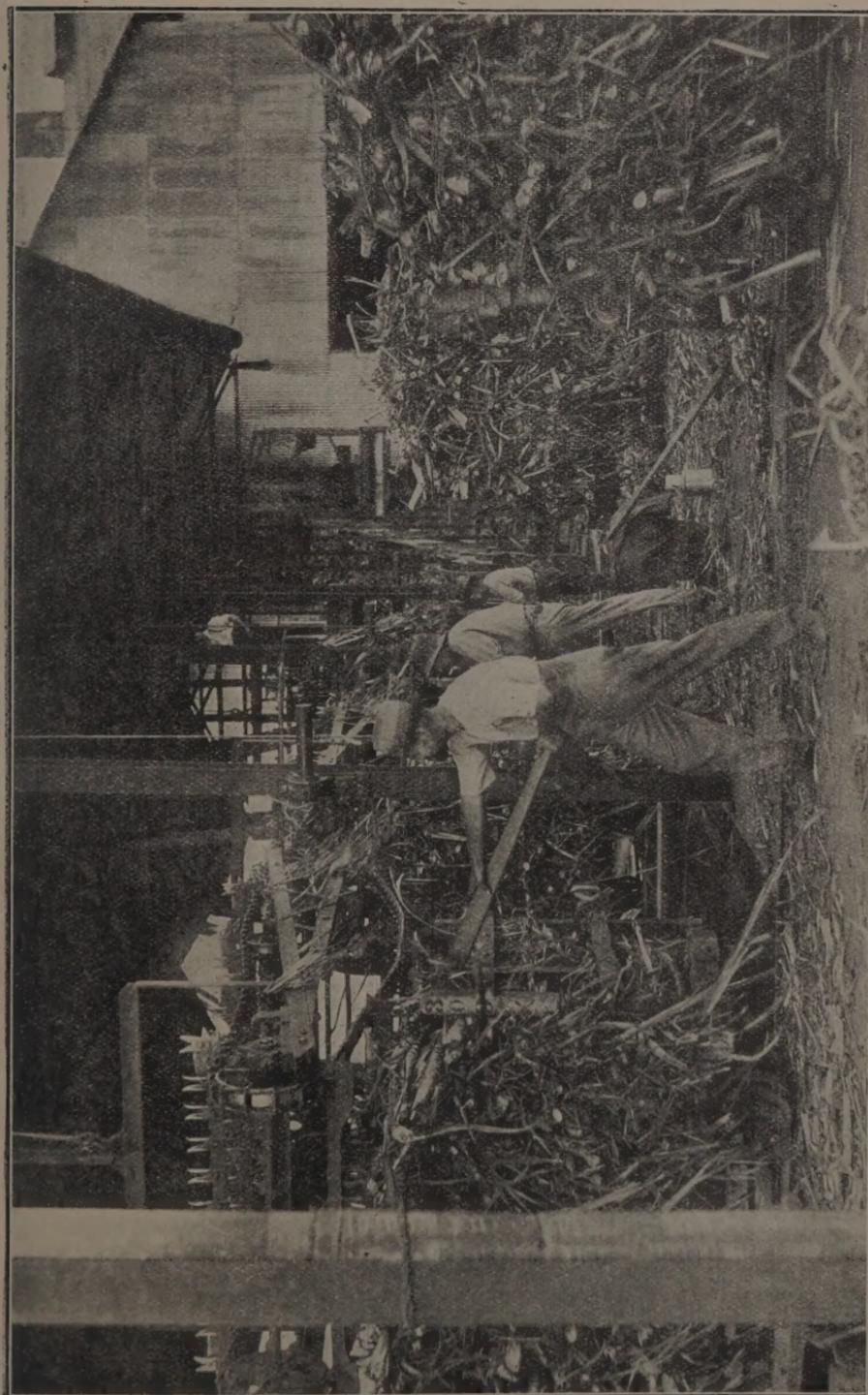


PLATE 1.—FEEDING CANE TO THE CARRIER, SOUTH JOHNSTONE SUGAR MILL.

The agreement for the payment of £30 6s. 8d. for raw sugar lasted for three years and expired in 1922. Strong endeavours were made to have it renewed as the sugar industry had made such great progress, due entirely to the feeling of security which had been engendered for the three-year period. For a short time the matter was in doubt, as there was a change in the Federal Parliament in 1922. Early in 1923 representatives of the Queensland Sugar Industry waited on the then Prime Minister, Mr. S. M. Bruce. The late W. N. Gillies, Minister for Agriculture, led the deputation and asked for consideration of the following resolution:—

“That in view of the fact that the effect of the current Sugar Agreement has been to substantially assist to stabilise the industry, and having regard also to the very great importance which the industry is economically, industrially, and nationally to the Commonwealth as a whole, and to the States of Queensland and New South Wales in particular, this Conference strongly urges upon the Commonwealth and State Governments the urgent necessity of renewing the Agreement, at the same price, for a period of five years,”

and also pointed out that the new sugar mill costing half a million, about to be erected by the Queensland Government to open up the jungle lands of the Tully River, was as good an investment for defence as a modern battleship, for it would settle men there who were prepared to fight, if needed.

The efforts of Queensland in this direction were supported by the New South Wales sugar industry, and also by the Victorian beet-growers.

The Commonwealth Government, however, were anxious to decontrol those industries (including sugar) which they had been handling during the War period, and declined to renew the agreement. Alternative proposals were submitted for the creation of a pool to handle sugar for five years, the importation of black-grown sugar during that period to be subject to embargo, the pool to place refined sugar on the market so that the price to the consumer should not exceed 4½d. per lb. Further discussions took place and the terms ultimately conceded by the Commonwealth were at that time felt to be disappointing, inasmuch as they did not secure that stability to the industry which it needed.

Briefly, the conditions were:—

- (a) That the industry should form a pool free from the control of the Commonwealth Government, to buy raw sugar for the 1923-1924 season at £27 per ton of 94 net titre, f.o.b. mill, and to enter into negotiations with the Colonial Sugar Refining Company to refine and distribute the sugar, the embargo against black-grown sugar to be continued till 30th June, 1925. After that the industry to be protected by means of a Customs duty in the same way as every other industry was protected.
- (b) The price for the 1924-1925 season to be determined after investigation by a tribunal and to be based upon the cost of efficient production in reasonably good districts and under normal conditions, such price not to exceed £27 per ton.

These conditions were finally accepted and a pool was formed, and the price for 1923 season was fixed at £27.

The tribunal just mentioned met in January of 1924, and after diligent investigation concluded that the price of £27 per ton of raw sugar was fair and reasonable.

The handling of raw sugar was controlled by a Sugar Board appointed by the Queensland Government.

The Prime Minister, however, later in the year 1924 visited Queensland, and stated that a dispassionate study of the history of sugar did away with the southern cry that preferential treatment was being given. He hoped to be able to announce at the earliest possible date the Commonwealth Government's policy with regard to the great sugar question.

During this year, 1924, Queensland produced more sugar than Australia could consume, which led to the export of a considerable tonnage. In order to meet the loss occasioned, the sum of £1 per ton of raw sugar was deducted from the price of £27 per ton.

In 1925, the promise of the Prime Minister was redeemed and an extension of the period of the embargo on the importation of sugar into Australia for three years was decided on. An agreement was entered into that refined sugar should be sold at 4½d. a lb., but carried certain concessions in prices to manufacturers. The sugar industry was to be responsible for any loss arising from surplus sugar exports, but the Australian price for raw sugar would be the same as in 1924 and 1925, namely, £27 per ton.

[TO BE CONTINUED.]

Bureau of Sugar Experiment Stations.

DWARF DISEASE OF SUGAR-CANE.

By ARTHUR F. BELL, Pathologist, Bureau of Sugar Experiment Stations.

DWARF disease is the name which has been adopted for an apparently new and serious disease of sugar-cane recently discovered in the Mackay district. Should this disease become widespread it would undoubtedly prove very destructive to certain varieties of cane, and this article has been written for the purpose of describing the symptoms of the disease and setting forth the situation for the benefit of canegrowers.

History and Distribution.

In 1930 Mr. A. P. Gibson reported that, as the result of a request received from a farmer, he and Messrs. Keogh and Osborn, of the Mackay Sugar Experiment Station, had inspected a field of plant P.O.J. 2714 and there found some 60 to 70 stools of cane affected with a disease with which they were not familiar. He further stated that in general appearance diseased plants resembled those infected with Fiji disease, but with the important distinction that no leaf galls were present. Two diseased stools were forwarded to this laboratory for examination and were received in good condition. Both consisted of dwarfed grass-like tufts, with yellowish streaked leaves, and greatly resembled extreme cases of Fiji disease, except that no leaf galls were present; they were also suggestive of the "lemon grass" stage of serch disease, but with the additional feature of numerous yellowish leaf streaks. In our opinion the disease could not be classified as any disease as yet recorded in Australia, nor, in spite of certain resemblances to serch and streak diseases, did it appear to be identical with any sugar-cane disease heretofore described in any other part of the world.



PLATE 2.

Leaves of diseased P.O.J. 2714, photographed by transmitted light. Streaks on left-hand leaf more closely resemble those of streak disease than is usually the case. Note uneven distribution of streaks in right-hand leaf and presence of yellowish marginal band on both leaves.

A subsequent inspection of the infected field confirmed the impression that we had to deal with a distinct disease, and a survey of the surrounding district was undertaken by Mr. Osborn, who was later joined by Mr. Wood. The result of the survey indicated that the outbreak was quite restricted in its incidence, and was mainly confined to the Rosella district. The presence of the disease was eventually established in fifteen fields distributed over nine farms, while a few doubtful stools were seen and destroyed on three other farms. The amount of infection per field varied from a single stool to a maximum of slightly less than .5 per cent. Regular inspections of these farms were continued and diseased stools rooted out, with the result that at the last two inspections the disease was found on four farms only.

With one exception (but see below) the only variety found to be infected on these inspections was P.O.J. 2714, and in this particular case five diseased stools of P.O.J. 2714 were found, in addition to one stool of P.O.J. 2714. On this farm also four stunted stools of E.K. 28 were found and destroyed, but the observer was unable to state definitely that the disease was dwarf disease. In five of the nine definite cases of the disease the stools of P.O.J. 2714 had been obtained from the farm on which the outbreak was first discovered, but the remaining farms had had no interchange of varieties. On one of these three cuttings of P.O.J. 2714 were received and planted in 1927, and all available supplies from the original stock were planted in 1928 and again in 1929; no disease was noticed until 1931, when one diseased stool was found in the ratoons of the 1929 plant, and approximately thirty stools in the 1930 late plant. The owner of the farm on which the disease was originally found received three sticks of P.O.J. 2714 in 1927; these gave rise to well-grown stools, which in 1928 were harvested and planted out in three rows. This cane was used in 1929 to plant two small blocks, one of which remained healthy, but in the other the 60 to 70 diseased stools mentioned above were found in 1930. An examination of the ratoons of the three rows from which these plants were taken revealed the presence of three diseased stools. Of these stools two were adjacent stools in one row, while the third was immediately opposite in the next row.

From the point of view of varietal susceptibility it is important to note that this particular farmer reported that early in 1931 he dug out a number of similarly diseased stools of H.Q. 426 (Clark's Seedling) in a field adjoining diseased P.O.J. 2714. This field was inspected on the occasion of the next visit, but no further infected stools were found. No definite observations on varietal resistance have been possible, but Q. 813 grown immediately adjoining the worst-infected field of P.O.J. 2714 has remained disease-free throughout.

Symptoms as Exhibited by the Variety P.O.J. 2714.

The leaves, particularly the younger leaves, of diseased canes are marked with fine longitudinal yellowish stripes. The stripes are usually short, $\frac{1}{2}$ to 2 inches long, but they may often be as much as 6 inches in length; they follow the direction of the veins and are about 1/16 inch wide, but may run together to give moderately wide bands, especially at the margin of the leaves. These markings are always more pronounced at the base of the leaves, and are not evenly distributed over the leaf surface as a rule. A good idea of the appearance of these leaf symptoms may be obtained by reference to Plates 2 and 3.

The leaves of diseased canes are stiff and erect, thus imparting a fan-like appearance to the cane top; the spindle and the younger leaves are usually twisted and deformed, of a lighter colour, and shorter than normal (Plate 4). As in the case of mosaic, there is a progressive masking of the streaks in passing to the older leaves, but with dwarf disease the older leaves are of a darker green than normal.

The most striking symptom is seen in the case of primary infection. Here the stool consists of a number of stunted shoots which form no cane; the leaves are erect, stunted, and clustered, and bear the typical yellowish streaks with, as a rule, scalded or reddish tips, margins, or stripes, and later becoming frayed and torn. The majority of the plants which we have produced by planting infected cuttings have died out without producing many shoots, but those which persist eventually produce a greater number of small shoots and resemble a tuft of grass. This stage of the disease much resembles extreme cases of serreh and Fiji diseases (Plate 6). Ratoon plants from diseased stools present a similar appearance and also form the grass-like cluster, with no production of cane. The life of such stunted shoots is usually very short.

In cases of apparently secondary infection, growth ceases suddenly and the top of the stalk tapers off to a point, forming the fan-like top. Such stunted stalks are soon outgrown by the healthy stalks in the same stool, and the upper internodes

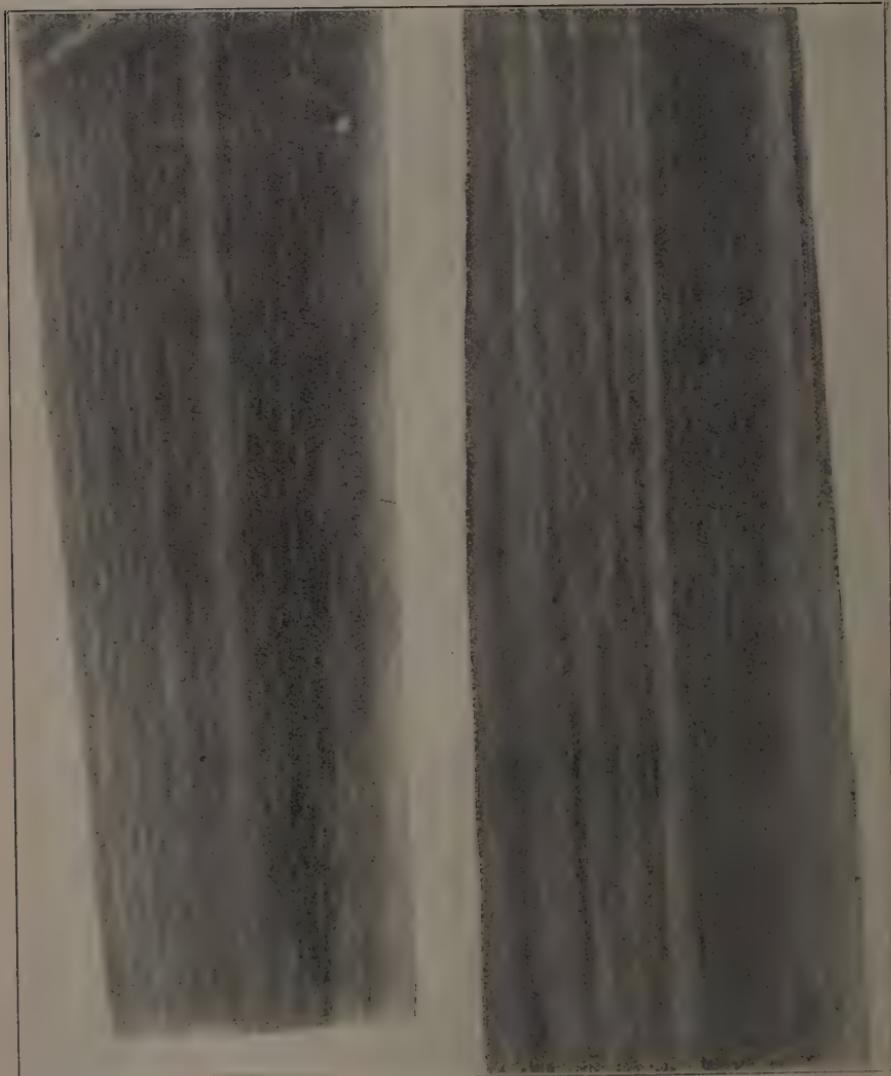


PLATE 3.

Similar to Plate 2 but photographed by reflected light.

become sunken. The general appearance of such canes is again very similar to cases of secondary infection Fiji disease. There is no marked shooting at the eyes or production of aerial roots by the diseased stalks, nor is there any discolouration of vascular or storage tissue, nor, in fact, any macroscopic abnormality.

Histological Examination.

A preliminary histological examination has failed to demonstrate the presence of any pathogenic organism within the tissues of diseased plants, but has revealed certain structural abnormalities which should form an interesting subject for subsequent examination. No definite abnormalities were observed in either stems or leaves of plants in which the infection was secondary, but a marked derangement of the tissues occurs in the vascular bundles of the leaves of the extremely stunted plants which result from primary infection. The derangement occurs to some extent in minor bundles, but is particularly associated with the major bundles, of which a typically distorted member is illustrated in Plate 7.



PLATE 4.

Stalk of P.O.J. 2714, illustrating production of fan-like top following secondary infection.

The bundle may be considerably enlarged, very irregular in shape, and frequently fused with an adjoining minor bundle. The chlorophyll-bearing sheath is incomplete, as a rule, and may be represented by a very few cells or be entirely absent in extreme cases. Within the bundle there is an abnormal development of comparatively thin-walled lignified cells which frequently radiate through the bundle in two or more strands, bringing about distortion and altering the relative positions of component tissues. Phloem may be almost entirely absent and confined to one of the resultant sectors, or may be found scattered in more than one sector or at the ends of the lignified strands. The walls of the cells of the lignified inner sheath surrounding the phloem appear thinner than is the case in normal cane, and the sheath is completely disrupted, but whether the strands of woody cells have their origin in this particular tissue has not been established.

Relation to Other Diseases.

The disease has features in common with Fiji, sereh, and streak diseases. The presence of the yellowish leaf streaks and the absence of galls on the undersurface of the leaves—which are particularly prominent in Fiji-diseased P.O.J. 2714—ruled out the possibility of identity with this disease. Similarly the presence of these leaf streaks and the absence of any internal discolouration and adventitious root



PLATE 5.

Typically stunted plant stool of P.O.J. 2714, 18 months old.

production strongly discounted the possibility of identity with sereh. In so far as streak disease was concerned, there appeared from the published report of Storey* to be considerable differences in colour, length, and distribution of the leaf streaks, as well as the degree of stunting of diseased plants. Particular significance was attached to these differences in view of the statement by Storey (page 7) that "The symptoms of streak disease show a remarkable uniformity throughout all varieties of cane affected." At that time, however, P.O.J. 2714 did not appear to have been exposed to streak disease in South Africa, and thus it was possible that the variations in symptoms might be due to a difference in varietal response. Accordingly, photographs, preserved leaves, and a description of the external symptoms were forwarded to Dr. H. H. Storey of the Amani Institute, and Mr. A. P. D. McClean of the Natal Herbarium, and their opinion sought as to the identity of the disease. Both these gentlemen have expressed themselves as definitely

* Storey, H. H. "Streak Disease of Sugar-cane." Union of South Africa, Department of Agriculture, Science Bulletin, No. 39, 1925.

of the opinion that dwarf disease is distinct from streak, although the leaf markings may bear a close resemblance at times. Dr. Storey directed attention to the following important differences between the two diseases:—

1. The stiff fan-like top occurs only in young streak-diseased Uba, and in later growth diseased plants are not noticeably different in habit from healthy plants.
2. The stripes of streak disease are white rather than yellow.
3. They are usually only a few millimetres long and rarely more than an inch in length.
4. The leaf markings are evenly distributed over the leaf in the case of streak.
5. There is no deformity of the inner leaves, and older leaves do not assume a darker green than normal.
6. There is no masking of streak symptoms in older leaves.
7. Such abnormally severe stunting has not been observed with streak, nor do shoots die prematurely.
8. Secondary infection causes no sudden cessation of growth.
9. Shrinking of internodes has not been noted.
10. Ratoons grow normally after an initial stunted stage.

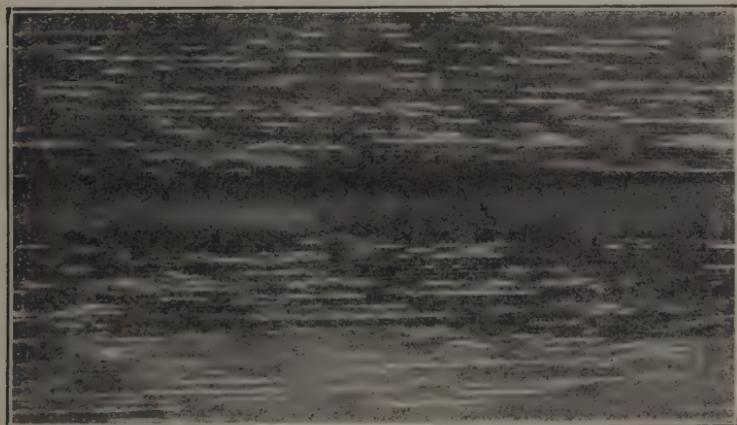


PLATE 6.

Streak disease in Uba. Compare with Plates 2 and 3.

Mr. McClean expressed similar views, and also stated that he has observed no case of streak disease in P.O.J. 2714, although this variety is now being grown in districts where 100 per cent. infection with streak may commonly be expected in susceptible varieties such as Uba.

In January, 1931, we were favoured with a visit from Mr. E. F. S. Shepherd, Botanist in the Department of Agriculture, Mauritius. After inspecting diseased plants Mr. Shepherd furnished us with a report in which he made, *inter alia*, the following remarks:—

“The streaks of dwarf disease are, however, in my opinion, usually longer than those encountered in streak disease and are not so uniformly distributed over the surfaces of affected leaves. The streaks of streak disease do not tend to fuse laterally to the same extent as do those of dwarf disease. The broad chlorotic bands towards the edges of leaves of dwarf disease affected canes do not, to my knowledge, occur in cases of streak disease, nor is there such a severe stunting of the shoots. Streak disease does not, to my knowledge, result in the death of shoots, which seems to be a constant character of dwarf disease. Dwarf disease has undoubtedly all the characteristics of a virus affection, but I am of the opinion that it is different from streak disease.”

Nature and Origin of the Disease.

The origin and cause of this disease are, as yet, matters for speculation only. It certainly has all the external appearance of being a disease of the virus degeneration disease type, and derangement of vascular tissue is frequently a concomitant of such diseases, but beyond this nothing definite can be said. In the preliminary examination in the field Mr. Wood was unable to find any associated organisms, but reported a necrosis of phloem tissue in the leaves of plants produced by the planting of diseased setts. In the laboratory a detailed histological examination has failed to demonstrate the presence of associated fungi or bacteria, nor have any attempts to isolate an organism been successful to date; but this phase of the work will be continued.

The presence of the disease cannot be correlated with any particular soil type, and planting of diseased cuttings under widely different conditions has always given rise to diseased plants, while parallel plantings of healthy cuttings have given rise to healthy plants in each case. So far the planting of cuttings from apparently healthy canes in diseased stools has also given rise to healthy plants. From the

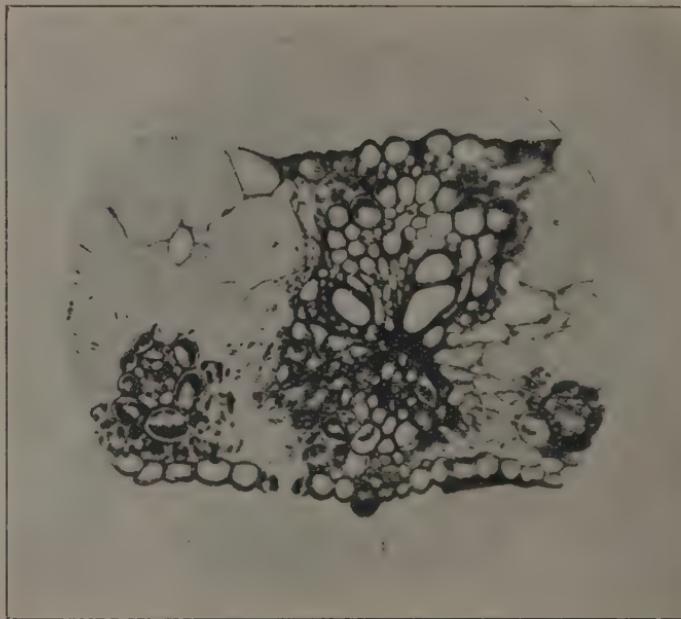


PLATE 7.

Cross section of major vascular bundle from leaf of P.O.J. 2714, showing abnormal development, presence of radiating strands of lignified tissue, and incomplete bundle sheath.

—From a freehand section made and photographed by Mr. Dormer.

results obtained by planting infected setts it seems unlikely that there is any prolonged masking of symptoms in the case of primary infection; assuming this point of view to be correct, secondary spread has been observed in a number of fields. The rate of spread has been comparatively slow and similar to what would be expected in the case of mosaic disease in a susceptible variety under similar field conditions. The results of secondary spread were most obvious during March and April, which is also a point of similarity with the spread of mosaic. Attempts at mechanical transmission by the use of the pinprick method developed by Sein* for the transmission of mosaic disease have so far given negative results.

* Sein, Francisco. "A New Mechanical Method for Artificially Transmitting Sugar-cane Mosaic." Journal, Department of Agriculture, Porto Rico, Vol. XIV., No. 2, p. 49, 1930.

Investigational work has been hampered by the fact that the outbreak occurred 600 miles from the laboratory, and also that as far as practicable diseased stools have been uprooted as soon as discovered. Attempts to maintain suitable experimental material in Brisbane have not been very successful, owing to the failure to produce plants consisting of other than small tufts of yellowish dying leaves; and pressure of other work has prevented the investigation of possible insect spread by the resident entomologist.

Three cuttings of each of the varieties P.O.J. 2714 and P.O.J. 213 were introduced from Java in January, 1922, along with P.O.J. 36, P.O.J. 100, P.O.J. 213, S.W. 3, D.I. 52, and F. 90. These canes were planted in the nursery of the Bundaberg Experiment Station and were grown under close supervision for some years, but no disease other than gumming disease was ever observed. P.O.J. 2714 and P.O.J. 213 from this stock are still being grown in the Bundaberg district, but have at no time exhibited symptoms of dwarf disease. Cuttings of these canes were sent to the Mackay Station in 1924 and propagated until 1927, when the first distribution was made. During the period 1927-29 many thousands of cuttings were distributed from Mackay Station to farmers in all parts of the State. Of the hundreds of farms to which the cane was distributed dwarf disease appeared on only four, which were all situated in the same locality (the plants on the five other positive and two doubtful farms were obtained from one of these four). On one of these four farms the disease did not appear until the second planting (three contiguous stools), and on another not until the third planting (one stool); the disease is so striking in appearance that it does not appear probable that it would be missed in small plantings. On each of the remaining two farms only a single stool was found, but these were found in the first planting.

From a consideration of the above facts there does not appear to be any likelihood of the disease having been introduced in cuttings from Java, quite apart from the fact that such a disease has not been reported from Java or any other country. The origin of the disease therefore remains a mystery; of the possible explanations of its appearance the most feasible at present is that the disease has been present in wild plants or other cultivated plants, and has been transmitted to sugar-cane following the growing of susceptible varieties. Such a possibility is, of course, by no means remote, and there are numerous instances of sugar-cane becoming infected with mosaic disease in this manner. Against this, however, is the fact that in spite of careful searching no suspicious symptoms have been observed on adjacent grass and weeds, but in this connection it should be borne in mind that the extremely droughty conditions prevailing over the past two seasons have been distinctly unfavourable for this type of observation.

Control.

From the rather limited field observations which it has been possible to make, this disease appears similar to mosaic and Fiji diseases in many respects, including the time and rate of spread. For this reason the methods which are so successfully used in the control of these diseases commend themselves for use in this instance. It is accordingly recommended that the following measures should be put into operation by growers:—

1. Study the symptoms of the disease in order to be able to recognise it in the field.
2. Carefully inspect, or have an officer of the Bureau inspect, any field (especially in the case of P.O.J. 2714, P.O.J. 213, E.K. 28, and Clark's Seedling) which it is proposed to use as a source of plants, and reject this field entirely if even a single stool of dwarf disease is found.
3. Inspect young plant and ratoon cane regularly and uproot any diseased stools as soon as they are found.
4. Keep fields and headlands as clean as possible.
5. Avoid planting P.O.J. 2714 if other varieties will give satisfactory yields.
6. In any case of doubt as to the presence of the disease, refer the matter to the nearest officer of the Bureau of Sugar Experiment Stations.

ENTOMOLOGICAL HINTS TO CANE GROWERS.

The Director of the Bureau of Sugar Experiment Stations has received the following Entomological Hints from Mr. E. Jarvis, Meringa, for the month of December:—

Introduction of Wasp Parasites of Cane Grubs from Philippine Islands.

During the last twelve months a number of living pupæ and adults of a Philippine digger-wasp, *Campsomeris auricollis* Lep., have been shipped to Cairns and reared through all life-cycle stages (from egg to wasp) at Meringa Experiment Station. This insect, which is known in its native haunts as the "Gold-collared Digger-wasp," bids fair to be of service in Northern canefields, since it readily attacks the grubs of our "greyback" cockchafer, and also those of two other beetles of economic importance, viz., *Lepidiota frenchi* Blkb. and *consobrina* Gir., the grubs of which occur commonly in Northern canefields. This useful Philippine parasite was found by us to complete its life cycle in practically the same time as that of our own Queensland digger-wasp, *C. tasmaniensis* Sauss. (42 days), a fact which is accounted for by the climate in Cairns being practically similar to that of the Philippines.

The first brood of these parasites was reared here in January last, and since that date two other broods have been propagated at Meringa with a view to getting up a stock for future liberations in grub-infested canefields.

Occurrence of French's Cane Beetle.

Farmers having crops of young cane, either plant or ratoon, situated close to land that was badly grub-infested last season, should be on the lookout for the presence of grubs of the cane beetle *Lepidiota frenchi* Blkb., a reddish-brown insect which is noticeably smaller than our greyback cockchafer. These grubs which have passed the winter in resting cells, and are at present in the third stage of growth (about 1½ inches long), have now risen nearer the surface to feed on cane roots. Growers should look out for first indications of such attack, which are very similar to those caused by our larger cockchafer. In the event of shoots of cane plants commencing to die in places, an examination should at once be made of the roots of affected plants, and if numbers of these grubs be found under a stool, the entomologist at Meringa Experiment Station should be advised in order that the matter may receive prompt attention.

In the present season the grubs of French's cockchafer are expected to cause their maximum amount of damage, which happens every second year; while the flighting of the adult beetles will be comparatively insignificant.

Growers should continue the cutting out of young shoots showing "dead hearts" (browning of central leaves) about 2 inches below ground level, and either burn or crush them to destroy caterpillars of moth-borers. These occur most freely in shoots of first and second ratoons, and of young plant cane; but will often attack the growing points of canes nearing maturity.

No time should be lost in locating the position of favourite food-plants of greyback cane beetles on which they may have been observed in times past to congregate. To facilitate the collection of this cockchafer it is advisable to clear away litter or vegetation from the ground surface under the proposed trap-trees. This work should be continued for about three weeks from the dates of each decided emergence.

If any farmer should chance to notice an unusual quantity of greyback beetles assembling on the ground, either close to his homestead or in any portion of his paddock, as though in response to some attractive influence, the entomologist at Meringa should be notified without delay, so that an immediate investigation may be made.

PLEASED WITH THE JOURNAL.

From a New Zealand correspondent (2/11/31):—

".... Very many thanks for the copy of the 'Queensland Agricultural Journal.' I read the pig article with great interest, and must say that your Journal is the best thing of the kind that I have seen."

MOLE DRAINAGE.

By H. W. KERR.

SUGAR-CANE is a crop which, while utilising large quantities of water in the production of heavy yields, desires essentially a well-drained soil, and will not thrive where water-logged conditions obtain for any appreciable period. Unfortunately, many of our cane lands are so placed that natural drainage is inadequate—at least for a portion of the year—and artificial drainage must be provided.

Drainage methods might be divided into two broad classes:—
(1) Surface drainage; (2) Sub-drainage. The former class aims at taking care of surplus water as it is received on the land, and hence might be regarded as preventive. Sub-drainage methods are designed to provide suitable conditions for the removal of the excess water from a soil which has become saturated. The relative values of the two types are governed entirely by local conditions of soil, topography and rainfall; and whereas surface drainage is eminently successful in certain areas, it fails almost entirely in others. It is a method which is freely adopted, for the construction of adequate surface drains and is a relatively simple and inexpensive consideration. But where sub-drainage is called for, growers are necessarily hesitant about installing the usually costly layout which is demanded.

The necessity for prompt action in this matter is keenly appreciated by many growers, and frequent inquiries have been made of late regarding the possibilities of an effective and inexpensive method of achieving their purpose. Undoubtedly the tile drain is the most satisfactory and permanent installation in this regard. This calls for the laying down of an extensive system of pipes which serve to conduct the excess water from all parts of the field to one or more main drains. When correctly installed, the results are, in general, highly satisfactory; but the cost of the work under present conditions renders it prohibitive in this country. An ingenious method of effecting the same end without recourse to costly tiles and their installation was devised in England, and an implement known as the Mole Drainer was manufactured by John Fowler and Company, of Leeds, for use with their steam tractors. The essential feature of this device is a torpedo-shaped piercer, which can be drawn through the subsoil at a convenient depth in such a way as to leave behind it a cylindrical tube in the substratum. Under suitable soil conditions the compaction of the walls of the tube by the piercer gives a measure of permanence to the structure, which is in effect a tile drain without the tile. The cost of the work is very much reduced by this expedient, and it has superseded the older method to a marked degree.

This implement could be operated, however, only on large-scale farms and plantations, and is entirely beyond the means of the individual grower. Recent attempts have been made, however, to adapt the principle, employing a simpler machine and designed to produce more modest results. An implement of this type has been employed successfully for some years in the cane lands of Fiji, and was introduced two seasons ago to the Richmond River district of New South Wales. Very encouraging reports have been received of the results obtained, and it was my privilege some few months ago to visit the area and spend a little time with the C.S.R. Company's officer, who was brought over from Fiji to take charge of operations. Unfortunately the implement

was not in use at the time, owing to continued wet weather; but a study was made of the outfit, and an inspection of the work which had been done by it during the previous season was convincing proof that the method offers decided possibilities for our wet Queensland cane lands. For the guidance of those interested in the system the following description of the mole drainer and the main points to be observed for successful operation are given.

The implement is really an adaptation of the Killefer Subsoil Knifer, which finds extensive use in Hawaii and elsewhere. It is a machine of robust construction, designed for draught by a heavy tractor, and operating a single subsoiling foot to a depth of 24 inches. The latter has been removed and replaced by the standard and foot shown.

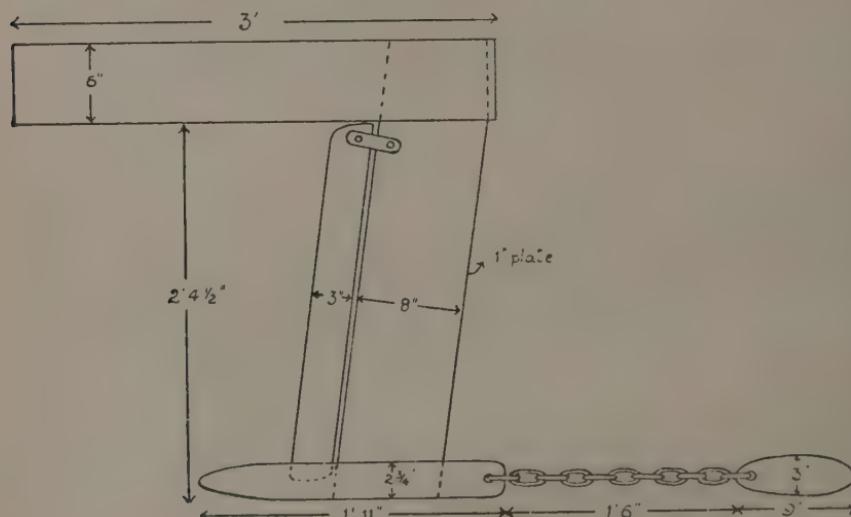


PLATE 8.

The essential features of this device are an 8 in. by 1 in. plate, terminating in a torpedo-shaped piercer 1 ft. 11 in. long. The standard is 2 ft. 10 1/2 in. in overall length, and is clamped at its upper end between the securing plates of the Killefer implement. A 3-in. blade coulter is attached as shown; this may be readily removed and renewed. Its purpose is to reduce draught and to obviate undue wear on the standard. This is considerable in a soil containing a proportion of sand. The piercer is $2\frac{3}{4}$ in. in diameter, and in passing through the subsoil leaves a cylindrical tube of this dimension.

At first sight it would appear that the gash created by the standard would assist in providing an adequate drainage channel for surplus soil water; but in point of fact it is a decided disadvantage, as, in times of heavy rain, soil particles are washed down into the tube and the silting up might be sufficient to put the latter out of action. Some attempt is made then to seal off the cut by drawing through an egg-shaped ball slightly larger in diameter than the piercer and attached to the latter by means of a chain. The result is partially successful, but

the gash left by the standard is still one of the disadvantageous features of the implement.

The Killefer carriage enables the moler to be operated with reasonable ease. The depth of working may be adjusted within limits, and a touch of a level raises or lowers the foot as required. For draught, a Caterpillar 30 tractor is used, and under the conditions obtaining it is mostly low-gear work. The usual depth of working is 18 in. to the bottom of the mole, but this may be varied somewhat, depending on the nature of the subsoil. The drains are constructed at 12-ft. intervals across the field, usually in the direction of greatest slope.

If a field is under consideration for mole drainage, a careful examination of soil and subsoil is made in order to determine its suitability for the purpose. The subsoil should contain a sufficiently high proportion of clay, in order that it may maintain the pipe; further, the job should be done when the subsoil is moist or even wet, so that it will mould well and not crumble. A sandy subsoil is quite unsuitable for mole drainage. Sandy pockets often occur in a field where the subsoil is otherwise suitable, and in such an event careful examination will show whether the incidence of sand will be so serious as to nullify the results of the work.

Having decided on the suitability of the block, the provision of adequate open discharge drains constructed along the lowest line of the field is essential. Where the field carries a slope in but one direction, the drains are open only at the lower end. The moler enters at the ditch and is drawn across the slope of the field, to be withdrawn at the opposite headland. The implement is returned to the ditch, and succeeding drains formed at 12-ft. intervals. Where a ridge runs across the block, two discharge drains will be required, and the mole drain is then constructed from ditch to ditch, giving a two-way discharge. To enable the open end of the drain to be readily located, and also to keep it open, a short length of 3-inch tubing may be inserted. Old boiler tubes cut to 15-inch lengths are very satisfactory for the purpose.

As the moler must necessarily conform with the land surface in carrying out the operation, the mole will, as a consequence, reflect any unevenness in topography. For most satisfactory results an even surface is desirable. A slight ridge running across the field might render a one-way drain partially ineffective.

The outfit employed in the Broadwater Mill area is capable of traversing four acres per day; and the cost of the operation to the farmer is fixed at 29s. per acre. The tractor and Killefer machine combined cost in the neighbourhood of £1,000. Of course this outfit enables a very efficient subsoiling job to be done, as an alternative, and on certain fields this has been carried out. The nature of the subsoil is then not so important, and when run at 4-ft. intervals across an average field the cost of the work is set down at 25s. per acre. Subsoiling is usually carried to a depth of 18 in. The results from the latter operation are quite marked, and it remains to be determined whether this practice is not equally as effective as mole drainage.

For the small grower who is anxious to possess a mole drainer for his individual use, a recently devised implement manufactured in England should have a decided appeal. Figure 2 gives some idea of the construction of the implement.

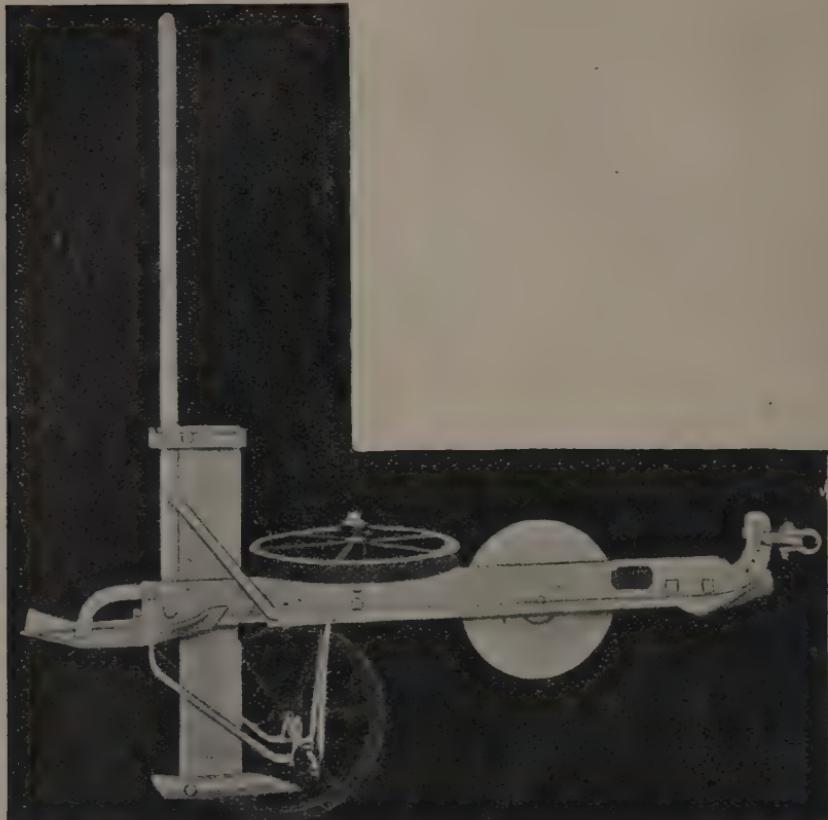


PLATE 9.

Fig. 2.—“Little Wonder” Mole Drainer, showing the Road Transport Truck partially removed. The wheel and lugs are removed when in use.

This implement weighs only $1\frac{3}{4}$ cwt., yet by reason of the construction the makers claim that it is “practically unbreakable.” The blade is of carbon steel and is reversible. It may be adjusted to drain any depth up to 19 in., and may be set at any pitch. The steel mole, with hardened point, is supplied at 2-in. or $2\frac{1}{2}$ -in. diameter; an interesting feature of the piercer is the compressor design which plasters the top of the drain hole and also makes it half an inch deeper. By lowering the handle the machine comes out of the ground immediately, and the horizontal wheel (which is part of the transport truck) is provided to enable the operator to steer when at headlands. By raising the handle the moler enters the ground before traversing a yard. It is claimed that a very narrow slit is cut in the earth, and it does not leave the objectionable V-shaped opening as is often the case.

The implement is quoted at £9 complete in England. It may be operated either by a light tractor or by a team of horses. If this mole drainer will live up to the claims which are made for it, it would be acclaimed by our growers. An order has been placed with the manufacturers by the Bureau, for the supply of such an implement, and on arrival it will be demonstrated to growers in all cane areas.

RED-STRIPE DISEASE OF SUGAR CANE IN QUEENSLAND.*

By W. COTTERELL-DORMER, Assistant Pathologist, Bureau of Sugar Experiment Stations.

PART I.

Introduction.

WHILE red-stripe was first recorded, as such, in Hawaii by Atherton Lee and Jennings⁸ in 1924, Tryon¹⁵ a year previously had published a description of the Queensland top rot, now considered to be identical. In Hawaii the first recorded outbreak of the disease occurred in the "Tip" canes of the Kohala district. During the inaugural conference of the International Society of Sugar Cane Technologists, held in Honolulu in 1924, many visiting pathologists were enabled to see this new disease in the field, and Mr. D. S. North¹² suggested that the top rot of Queensland might be identical with red-stripe. Evidence supporting this suggestion was obtained from some inoculation experiments carried out by the present writer in 1926.⁵ As a result of further work we now consider that the two diseases are the same, though some minor differences do exist, as will be pointed out later. Since 1924 red-stripe has been recorded in Java by Bolle,² in the Philippines by Atherton Lee and Dwight Pierce,¹⁰ and in Louisiana by Edgerton and Christopher.⁶ and ⁴.

A disease called "Polvillo," much resembling red-stripe, was recorded in cane in Argentine by Spegazzini in 1895 and by Fawcett⁷ in 1922, but none of the descriptions given by the latter, of the organisms isolated from affected stems, agree with that of the causal organism of red-stripe.

Red-stripe has been known in Queensland for many years under such names as top rot, cane rot, Burdekin rot, &c. The first investigation was made by Tryon, who studied the disease in the field during a severe outbreak on the Herbert River in 1903. In his report¹⁵ he states that at that time one grower could remember the disease in the district as early as 1882, so it is possibly safe to say that red-stripe has been in Queensland for at least fifty years. It would appear to be present in every cane-growing district in the State, though it is most active in the more northerly regions.

The investigation described in the following pages was undertaken primarily to find out whether the Queensland top rot was red-stripe disease. The work has been carried out under the guidance of Mr. A. F. Bell, Pathologist to the Bureau of Sugar Experiment Stations, whom the writer sincerely thanks for his advice and kindly criticism throughout. To Dr. H. W. Kerr, agriculturist, to Mr. A. P. Gibson, field officer, and to other officers of the Bureau, acknowledgment is made for their ready help in field and laboratory. Thanks are also due to Mr. C. T. White, Government Botanist, and Mr. C. E. Hubbard of Kew, for identifying some of the grasses which were used in the study of host relationships.

* Thesis submitted in partial fulfilment of the requirements for the Degree of Bachelor of Science in Agriculture with Honours at the University of Queensland, Brisbane, 1931.

Description of the Disease.

Red-stripe is characterised by two very definite and quite distinct types of lesion; that caused by infection of the leaves, and that caused by infection of the stem.* These two phases may occur together in a field, stool, or stalk of sugar-cane, or either phase may be found alone at a given time.

Descriptions will now be given of these lesions as they appear in Badila, which is the variety most commonly affected in Queensland.

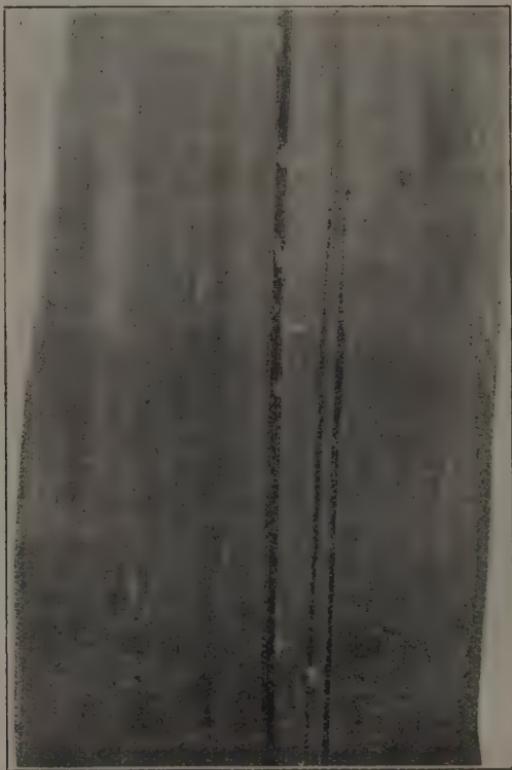


PLATE 10.

A characteristic of the leaf lesions of red-stripe is the presence of exudation stains on the lower surface of the stripes. These stains are clearly shown in this photograph of portion of a Badila leaf.

The first visible indication of red-stripe infection of the leaves is the presence at the base of one or more leaf blades (usually on the half unfurled, or first fully unfurled leaf) of a narrow, dark watery-green, longitudinal stripe about half an inch to one inch in length and one-sixteenth of an inch in width. This stripe elongates very rapidly in warm humid weather, and as it becomes older, gradually changes in colour from watery-green to watery-brown or yellow and then to bright blood-red. Fresh stripes are meanwhile formed on the same and

* For the purposes of this discussion the word *stem* will be taken to signify the actual stick of the sugar-cane, while the word *stalk* will mean the stick together with its "top" and leaves.

younger leaves, and unless some climatic or other factor not yet understood intervenes, the infection may progress until all of the younger leaves are blazoned with brilliant red lines. These frequently coalesce, forming bands which may be half an inch or more in width and 2 feet or 3 feet in length.

Red stripes may be formed in any portion of the leaf, though it is the general rule for them to take their source at or near the base of the blade; they are often found on the underside of the mid-rib where they usually attain their greatest length. When infected leaves become old, prior to being cast off by the plant, the red stripes wither and frequently assume a chocolate-brown colour.

A very noticeable feature of typical red stripes is that they are almost invariably splashed here and there on their lower side along their whole length by reddish-brown or white stains (see Plate 10). These result from the drying of a bacterial exudate formed during their growth, and are of diagnostic value. Exudation rarely occurs after sunrise, but at night and during the early morning, if the atmosphere be fairly moist, many drops of exudate may be found along the stripes and also at recently infected points which may not show stripes until a day or so later.

In Badila it is rarely that the stripes are found to extend from the leaf blade into the leaf sheath. However, in some canes, notably P.O.J. 2714, the stripe is able to travel right down the leaf sheath and into the stem (see Plate 11).

The second phase of the disease—namely, that of stem infection—is characterised by death and decay of the tissues of the cane stem, commencing, usually, in the vicinity of the top or growing point. The first outward evidence of this phase is the faint smell of decaying fruit which emanates from the base of the "heart." If such a stem be now examined more closely, the middle-aged leaf sheaths will be found to be turning red, and, if pulled away from the stalk, small bright blood-red splashes will be found on their inner surfaces. These are usually accompanied by a few water-soaked streaks reaching almost up to the ligules. The portion of each internode just below the junctions of these two or three young leaf sheaths with the stem is found to be somewhat sunken in spots. These sunken areas are water-soaked and brown to red in colour. If the leaf sheaths be torn off, the exposed tissues at the wounds thus caused are found to be marked with red dots. Now, if the stem be split in two, the apical growing point and the base of the very young immature leaves will frequently be found to have commenced to decay and to turn red or brown in colour. Exposure to the air will also cause these very young tissues to turn brown.

Later the leaves of the affected stems gradually wilt and yellow, this wilting usually commencing with the younger leaves. Growth of the "top" continues for some time after infection, but at a gradually decreasing rate with a consequent shortening of the distance between the leaves, thus producing a bunched-up appearance. Meanwhile decay progresses rapidly within the stem and the symptoms already described become much accentuated.

The periphery of the internal affected regions is frequently marked by a narrow dark-red margin which reaches the rind at the sunken portions just below the internodes. It is deflected towards the central axis in the vicinity of the buds and is furthest from the rind in the

main body of the internode. Sometimes it is so well developed as to produce a closed figure in section, but this is not usually the case. The portion enclosed by this red border, where actual decay has not occurred, has a slightly water-soaked appearance.

A good deal of slimy, evil-smelling fluid is produced at the base of the "heart" and within the leaf-sheaths. The inner surfaces of the



PLATE 11.

In the case of Badila, the stripes seldom extend beyond the leaf blade, but in some varieties they are able to travel right down the leaf sheath and into the stem. This stalk of P.O.J. 2714 is affected in such a manner.

latter become stained dark-red almost throughout. The internal "heart" leaves, being protected from desiccation, may remain green for some time, but their growth ceases, while that of the surrounding leaf sheaths may slowly continue until the disease becomes very far advanced. This growth causes the "heart" leaves to be carried upwards and consequently to be torn at their base, with the result that a cavity is formed

there and the "heart" can easily be pulled out. Usually the apical growing point and youngest immature nodes by this time are somewhat decayed and also are carried upwards, leaving another cavity at the apex of the stem proper. One or more other cavities may similarly be formed further down the stem (see Plates 12 and 13).

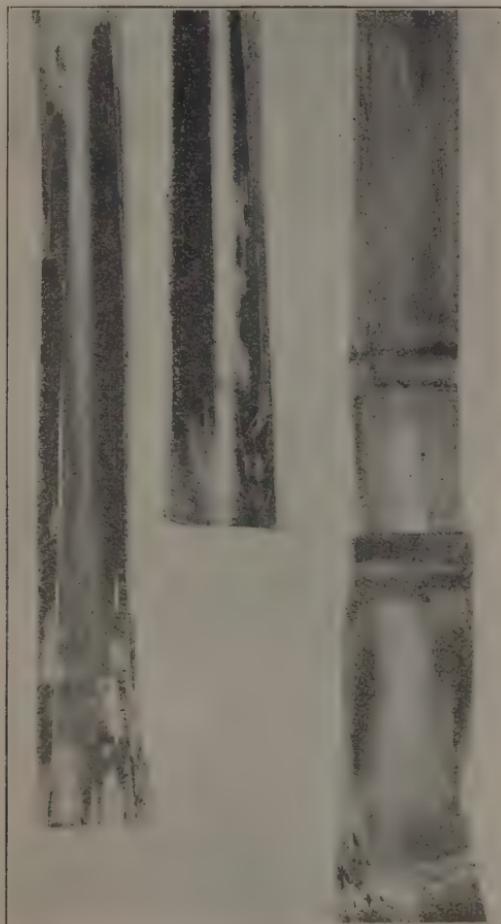


PLATE 12.

Bands of dark, rather sunken, water-soaked tissue immediately below the younger nodes. Blood-red splashes of colour on the inner surface of leaf sheaths. These typical symptoms of top rot are seen on this Badila stalk.

Rotting may continue until all the immature portion of the stem becomes decayed and wrinkled, and all of the leaves die, after which the stem top will usually fall over, leaving a stump which may or may not become rotted down to its base below the soil surface. If this does not happen the lower buds, if not infected, and sometimes the root

eyes, are stimulated by the failure of the cane foliage and shoot promiscuously.

Although the two phases of the disease have been described separately, it should be stated that in most cases they occur together. Numerous observations of individual stalks exhibiting the red leaf stripes have shown that many of these develop stem infection three to



PLATE 13.

A longitudinal section through the stalk shown in Plate 12. Rapid decay has completely destroyed the apical growing point, and several cavities have formed within the stem.

six weeks later, or even sooner. The course usually followed by the disease in a field is as follows:—Red stripes appear on the leaves about October and November, though they may be found earlier if carefully sought. Then during December a few stalks will be found showing

stem infection, or what is commonly known as top rot. In January and until March or April this phase becomes more evident, and decaying stems will be found, in one-year crops, right up to the time of harvesting.

ETIOLOGY.

When this investigation was taken up it had yet to be demonstrated that top rot and red-stripe were identical, so the etiology of the former was studied as though for the first time.

Preliminary Experiments.

Early in 1926 at Ayr, North Queensland, the writer⁵ examined microscopically some red leaf stripes from top-rot infected stools and found them to be teeming with bacteria. Some mixed cultures of these bacteria were then made on sterile potato slices. Suspensions of the bacterial growths obtained were made in sterile water, and by means of leaf punctures and hypodermic inoculations with these suspensions all of the leaf and stem symptoms of top rot were reproduced on Badila plants. Some of the inoculated stalks were wrapped with damp cotton wool and waxed paper, and others not. The most virulent lesions were obtained on the latter. Red stripes were also produced without any wounding by pouring some of the suspension into the base of the "heart," or even by merely placing some of it on either surface of the bases of young leaf blades. Fresh cultures were prepared from artificially produced stripes, and similar results were obtained when these were used as inoculum. Facilities for pure culture work were not available at the time, but these experiments showed that top rot was almost certainly a bacterial disease and that the causal organism could be cultured readily.

In January, 1930, the study of the etiology of top rot was resumed at Ayr. In order to find a suitable medium on which to isolate the causal organism, mixed cultures were made on 1 per cent glucose beef-extract peptone agar, and Brown's synthetic medium³ of varying degrees of acidity, viz.—pH 5.5, 6.0, 6.7, 7.0, and 7.5. Two series of leaf-puncture inoculations were made with these mixed cultures, five stalks being inoculated from each culture. Two days later many young stripes were visible and the most vigorous of these originated from inoculations made from a culture grown on Brown's medium with reaction adjusted to about pH 6.7. This medium was used exclusively in all the isolation and inoculation work which ensued. Its composition, as used by the writer, is as follows:—

Glucose	..	..	..	..	..	2.00 gms.
Asparagin	..	..	..	..	..	2.00 gms.
K ₂ PO ₄	..	..	..	..	..	1.25 gms.
MgSO ₄ ·7H ₂ O	..	..	..	..	..	0.80 gms.
FeCl ₃	..	..	..	..	..	trace.
Normal HCl	..	..	..	..	..	4.4 cc.
Water	..	..	..	..	..	1000.0 cc.
Agar	..	..	..	..	..	20 gm.

NOTE.—If 1 gm. of K₂HPO₄ be used in place of K₂PO₄ no acid need be added.

In making the medium it was found desirable to bring the mixture of the constituents to the boil and filter through filter paper before adding the agar. A very clear medium is obtained in this way.

Isolation of the Causal Organism from Leaf Lesions.

Isolations were made as follows:—

After surface sterilisation of the leaf with alcohol and flaming, a small portion of the stripe tissue was removed and macerated under aseptic conditions and then mixed with 5 ccs. of sterile water. The resultant suspension was then allowed to stand for half an hour before inoculating tubes for the pouring of dilution plates.



PLATE 14.

Typical red-stripe lesions produced by artificial inoculations are seen on these two stalks of Badila.

As no incubator was available these and all subsequent cultures were kept under observation at room temperature, the diurnal range at the time being about 26 deg. C. to 30 deg. C.

Three series of dilution plates were poured on 15th January, 1930. Twenty-four hours later a number of small white bacterial colonies made their appearance on the plates poured from one of the stripes, while no growth was visible on the other three. After thirty-six hours

these colonies had reached a diameter of 2 mm. and had begun to alter in colour to yellow. After forty-eight hours from time of planting another type of bacterial colony could be seen on all plates. These new colonies were very small, watery, and shiny. Of the three plates from the second stripe two appeared to be pure cultures of this new type of colony, while the third plate contained a mixture of the two types of bacterial colonies. Sub-cultures were now made on agar slopes of two yellow colonies (Nos. 1 and 2), and of two of the small colonies (Nos. 3 and 4). The original plates were kept under observation, and it was found that the larger colonies eventually assumed a bright mustard-yellow colour and attained a diameter of up to 6 mm., while the small



PLATE 15.

A naturally occurring case of red-stripe in Badila. (cf. Plate 14.)

colonies soon became creamy white and retained their glistening appearance; they reached a diameter of up to 3 mm. On the 18th the cultures were again "subbed" and a series of leaf-puncture inoculations made.

Unless otherwise stated the experimental cane was vigorously growing Badila (N.G. 15) planted in May, 1929. In all series of inoculations great care was exercised in choosing canes which were

free from all marks or deformations which might later cause a misinterpretation of results. All canes were labelled before inoculation, the label being attached to the mid-rib of the leaf immediately below the leaves intended for inoculation or as controls. As the attachment of the labels involved a certain amount of injury to the leaf tissue, the hands were washed in 5 per cent. lysol between the labelling of each group of canes.

Agar slant cultures formed the standard inoculum, but watery suspension and liquid cultures were also frequently used. The inoculations were made on the under surfaces of the first and second fully unfolded leaves, at a point 1 to 2 inches above the junction with the leaf sheath. The mode of inoculation consisted in smearing the inoculum on one wing of the leaf-blade with a sterile needle and making a few shallow punctures within the treated area. Apparatus was sterilised and the hands of the operator washed in lysol between each series of inoculations. In the case of the controls the leaves were punctured with a sterile needle after smearing with sterile water.

The above methods proved quite adequate as is evidenced by the facts that all control punctures remained definitely 100 per cent. negative, and on no occasion was there any carry-over between the various cultures.

TABLE I.
SERIES A.—INOCULATIONS (18TH JANUARY, 1930).

Culture.	POSITIVE RESULTS.	
	January 20.	January 30.
	Per cent.	Per cent.
1	0	0
2	0	0
3	100	100
4	100	100
Check	0	0

INOCULUM.—Suspensions in sterile water of cultures 1, 2, 3, and 4, mentioned above. Five stalks inoculated with each culture, and five checks with sterile water.

Conclusion.

The organism growing on slopes 3 and 4, namely the bacterium which produced the shining white colonies, appeared to be the pathogen.

NOTE.—Culture No. 4 was replated on 20th January to ensure that pure culture was being used—no other organisms were found present. For the sake of convenience the organism grown in Cultures Nos. 3 and 4 was thenceforward referred to as Organism W.

Reisolation of the Causal Organism from the Leaves.

On 30th January, 1930, watery green stripes which had been produced from leaf-puncture inoculations with cultures No. 3 and No. 4 were collected from Series A. Three separate plates were poured from

material from each of these stripes. On the 23rd all of the plates from one stripe (No. 3) yielded only small colonies of organism W. One plate from the second stripe contained one colony of organism W; the second plate one of organism W and one yellow colony; and the third one fungus colony. One colony of Organism W was selected and four consecutive dilution slopes planted to ensure the obtaining of a pure culture. Clearly defined separate colonies were obtained in this way, and on the 24th two slopes were planted.

TABLE II.
SERIES B.—INOCULATIONS (25TH JANUARY, 1930).

Organism Used.	Number of Stalks.	POSITIVE RESULTS.		
		January 27.	January 30.	February 13.
		Per cent.	Per cent.	Per cent.
W	30	100	100	100
None	30	0	0	0

INOCULUM.—Pure slope culture of reisolated organism W to which 3 ccs. of sterile water had been added. Controls inoculated with sterile water.

Conclusion.

Koch's postulates have been fully satisfied. Organism W is constantly found in the lesions of the leaf-infection phase of the disease. It has been isolated from such lesions, and leaf inoculations made from pure cultures of it have in all cases given rise to typical leaf stripes. It has been re-isolated from these artificially produced lesions, and inoculations have been made with the re-isolated organism have again, in all cases, given rise to typical lesions (see Plates 14 and 15). Hence Organism W must be considered to be the causal agent of the red leaf stripes which have been described.

Confirmatory Inoculations.

On 23rd January two pure cultures of Organism W, one planted from the original isolation culture and the other from a re-isolation colony, were sent to Mr. A. F. Bell, in Brisbane. On receipt of these cultures, sixteen stems of N.G. 15 growing in the University isolation plot were inoculated by Mr. Bell and Mr. Ferguson Wood. Both strains of Organism W gave 100 per cent. positive infection, thereby confirming the results obtained by the writer at Ayr.

Susceptibility of Various Portions of the Cane Stalk to Organism W.

In order to determine the relative susceptibility of the various portions of the cane stalk to attack by Organism W, a further series of inoculations was carried out (Series C). In this series a watery suspension of a pure culture of Organism W was injected into various parts of the cane stem and "top" extending from the lower mature internodes up to the ligule of the first unfolded leaf. Sixty stalks were inoculated with the suspension, and twenty as controls, with sterile water. Inoculations were effected by means of a sterile hypodermic

syringe, about 0.25 cc. being injected at each inoculation, one puncture being made in each stalk, and aseptic conditions were maintained as far as possible as in the two previous series. In each case the needle was forced about half-way through the stem. The locations of the punctures may be classified as follows:—

- A. Through ligule of first fully unfolded leaf.
- B. Two or three inches below the ligule mentioned in A.
- C. In vicinity of apical growing point, above, or below.
- D. A pink semi-mature internode.
- E. A mature internode.

TABLE III.
SERIES C.—INOCULATIONS (21ST JANUARY, 1930).

Stalk No.	Portion Inoculated.	Observations.					
		24/1	27/1	28/1	29/1	6/2	29/2
1	A	a	a		a	a	a
2	A		a		a	c	c
3	A				Lost	b	b
4	B					b	b
5	B					b	b
6	B					b	b
7	B					b	b
8	B					b	b
9	B					c	c
10	B					b	b
11	B					b	b
12	B					b	b
13	B					b	b
14	B					c	c
15	B					c	c
16	B					a	a
17	B					a	a
18	B					b	b
19	B					b	b
20	C					b	b
21	C					b	b
22	C				+	b	b
23	C					b	b
24	C					b	b
25	C					b	b
26	C					b	b
27	C					b	b
28	C					b	b
29	C					b	b
30	C					b	b
31	C					b	b
32	C					b	b
33	C			b		b	b
34	C		b		+	b	b
35	C		b			b	b
36	C		b			b	b
37	D					b	b
38	D					b	b
39	D					b	b
40	D					b	b

TABLE III.—*continued.*

Stalk No.	Portion Inoculated.	Observations.						
		24/1	27/1	28/1	29/1	6/2	14/2	22/2
41	D				b			b
42	D				b		†	b
43	D				b			b
44	D				b			b
45	E				b	*		*
46	E				*			*
47	E				*			b
48	E				*			*
49	E				*			*
50	E				*			*
51	E				*			*
52	E				*			*
53	E				*			*
54	E				*			*
55	E				*			*
56	E				*			*
57	E				*			*
58	E				*			*
59	E				*			*
60	E				*			b
1	A					†		†
2	A					†		†
3	A					†		†
4	B					†		†
5	B					†		†
6	B					†		†
7	B					†		†
8	B					†		†
9	C					†		†
10	C					†		†
11	C					†		†
12	C					†		†
13	C					†		†
14	C					†		†
15	C					†		†
16	C					†		†
17	D					†		†
18	D					†		†
19	E					†		†
20	E					†		†

EXPLANATORY NOTE.

a Red leaf stripes produced.

b Top rot produced but no leaf stripes.

c Both top rot and leaf stripes produced.

* Localised reddening of stem tissue.

† Stem and leaves remain quite normal.

‡ Stalk removed for examination.

INOCULUM—Suspension in sterile water of a pure culture of organism W; controls inoculated with sterile water.

Discussion of Results (see Plate 16).

Inoculations made through ligule of first fully unfolded leaf (A) quickly gave rise to typical red leaf stripes, in one case later developing into top rot. Those made 2 or 3 inches below this ligule (B) gave rise in two cases to red leaf stripes alone, in three cases to leaf stripes followed by top rot, and in the remaining eleven stalks to top rot alone.

Inoculations made in the vicinity of the apical growing point, above or below (C), gave rise to top rot without leaf stripes in all of the eighteen stalks so inoculated; in about 60 per cent. of those stalks the early top rot symptoms, namely wilting and yellowing of leaves accompanied by a smell of decay, were present after six days from the time of inoculation.



PLATE 16.

A view of some of the stalks used in Series C inoculations. The three stalks on the left are Nos. 8, 9, and 29 of the series, while the remaining two stalks are healthy. Retarding and final cessation of growth, wilting, decay, and the production of lateral shoots are some of the top rot symptoms shown.

Most of the stalks which were inoculated at a pink semi-mature internode (D) were slow in showing symptoms, but in all cases top rot without leaf stripes was developed in a form more severe than from most of the other inoculations in that decay travelled much further down the stem—as far as the mature internodes. The stalk “top” also rotted and fell over, leaving stumps from which shoots and latent

roots sprouted freely. One such inoculated stalk was carefully examined three days before any sign of wilting appeared, and it was found that the internal reddening of the leaf sheaths and the dark sunken areas below the younger nodes, which denote the presence of top rot, were very evident. The leaves of all but two of the stalks inoculated at a mature internode (E) remained quite normal, but a localised reddening of the cane "flesh" was noticeable in all cases, and a longitudinal splitting of the rind in most. The remaining two of this group of stalks developed top rot without leaf stripes, about one month after inoculation.

All controls remained normal in every respect.

Conclusion.

All of the symptoms of top rot, with or without leaf stripes, may be produced by inoculation of cane stalks with a pure culture of Organism W. The most destructive lesions would appear to occur when infection takes place through the semi-mature internodes, while the mature portions of the stem appear to be much less susceptible.

The results outlined above would explain the appearance in a field of top rot without leaf stripes—this could well be due to natural infection of the fairly exposed semi-mature parts of the cane stems. Also such infection would explain the suddenness with which top rot usually appears in a field, since badly infected stalks may seem quite normal until two or three days before yellowing and wilting of leaves occur.

Isolation of Organism W from Stalks.

During the course of the work described above a few preliminary leaf inoculations were made using as inoculum stalks in which the top rot stage was well developed but which bore no leaf stripes, both directly and in the form of mixed cultures. About 10 per cent. of these inoculations resulted in typical red leaf stripe infection. Similar inoculations made into cane "tops" gave rise to a small percentage of top rot infections. These results supported the view that top rot was probably caused by Organism W even in the absence of leaf stripes.

Attempts were now made to isolate Organism W from well developed top rot lesions without red leaf stripes, but these were unsuccessful. These failures were attributed to the influence of competitive saprophytic organisms hence it was decided to use younger lesions for the purpose.

On 6th February, 1930, five naturally infected stems were selected which showed the early symptoms of top rot, namely, wilting of leaf blades and slight reddening of leaf sheaths, but no red leaf stripes whatever. One middle-aged red stripe and one watery green stripe were also collected from two other stalks. The leaf sheaths of the top rot infected stalks were now carefully pulled and cut away, leaving the stems exposed. These were found to present the typical symptoms of top rot infection, consisting of a band of slightly sunken water-soaked tissue about $\frac{1}{4}$ in. wide immediately below the upper nodes. In the case of the white immature internodes this tissue was light-red in patches; on the semi-mature internodes it was dark red, turning to brown in spots. One of these lesions was washed with alcohol and flamed in the case of each stalk. Of the internodes selected one was white, three were pink semi-mature, and one was darkening and sub-mature. From each selected lesion a small piece of infected tissue was now cut out

and crushed on a sterile slide and then dropped into about 6 ccs. of liquid medium. A portion of each of the leaf stripes was similarly treated. The seven tubes were then well agitated and allowed to stand for three hours, after which time a series of dilution plates and slopes was prepared from each and numbered 1 to 7. Nos. 6 and 7 being from the leaf stripes. After three days typical glistening colonies of Organism W were found on all of the plates and tubes. One of these colonies was then selected from each of Series 1 to 5, and from Series 7 and "subbed" on agar slopes which were respectively numbered 1.1, 2.1, 3.1, 4.1, 5.1, and 7.1, and used in the following series of leaf-puncture inoculations in order to prove the identity of the organism isolated. As it was known that unfavourable weather conditions or the unsuitability of the cane inoculated will sometimes inhibit the production of lesions, some leaves were inoculated with a strain of Organism W whose pathogenicity had been previously demonstrated. Inoculations were made directly from the agar slopes without the addition of sterile water. Controls were pricked with a sterile needle. The same precautions were taken to ensure aseptic conditions as have already been described.

TABLE IV.
SERIES D.—INOCULATIONS (10TH FEBRUARY, 1930).

Culture Used.	Number of Stalks Inoculated.	Positive Red Leaf Stripe Infections on 17th February, 1930.	Per cent.
1.1	10	100	
2.1	10	100	
3.1	10	100	
4.1	10	100	
5.1	10	100	
7.1	10	100	
W	10	100	
None	10	0	

NOTE.—All of the lesions produced were very definite, and were identical with infections occurring naturally in the field at the time.

Conclusion.

By plating material obtained from young top rot lesions occurring in the outer regions of the stem and in the vicinity of the junction of the leaf sheaths and the stem, Organism W can readily be isolated from naturally occurring top rot infected stalks, though their leaves do not bear any red stripes.

Reisolation of Organism W from a Stalk Artificially Infected with Top Rot.

On 14th February, 1930, Series C inoculations (see Table III.) were visited and stalk No. 42, which showed typical infection of top rot without red leaf stripes, was selected. As in the last series of isolations discussed above, some material was cut away from the band of infected tissue on a semi-mature internode, crushed, and allowed to stand for some time in liquid medium from which five dilution stroke cultures

were prepared. After forty-eight hours the latter were found to contain great numbers of large yellow colonies interspersed with a few small colonies of Organism W. One of these was sub-cultured and used for carrying out a further series of inoculations.

TABLE V.
SERIES E.—INOCULATIONS (26TH FEBRUARY, 1930).

Metho l of Inoculation.	Inoculum.	Number of Stalks Inoculated.	Lesions showing on 11th March, 1930.
Leaf puncture	Organism W	10	100 per cent. with red leaf stripes.
Leaf puncture	Check ..	10	Nil.
Hypodermic injection in vicinity of growing plant	Organism W	10	100 per cent. with top rot, no leaf stripes.
Hypodermic injection in vicinity of growing point	Check ..	10	Nil.

Conclusion.

The last two series of isolations and inoculations discussed demonstrate beyond question that Organism W is the causal agent of the disease hitherto known, in Queensland, as top rot.

The Production of Top Rot Lesions by Leaf Puncture Inoculation.

During the course of field and experimental observations it was noticed that stalks showing typical red leaf stripes frequently developed top rot some weeks later. The later history of Series B inoculations (see earlier) is a case in point. In this series of inoculations the leaves of thirty stalks were inoculated with a pure culture of Organism W and thirty controls with sterile water on 25th January. On the 27th all of the thirty inoculated stalks showed typical early leaf symptoms, the checks being unaffected. On 13th February four of the inoculated stalks had developed top rot. Six days later twenty-six of the inoculated stalks were showing typical top-rot symptoms accompanied by red leaf stripes, while the thirty checks still remained perfectly healthy. Thus of the thirty stalks whose leaves were inoculated with Organism W in pure culture, about 87 per cent. developed top rot less than four weeks later. This percentage appears to be much higher than when infection occurs under natural conditions.

Summary of Isolation and Inoculation Experiments..

1. Organism W was first isolated from red leaf stripe lesions.
2. It was then used in pure culture to inoculate twenty leaf blades and 100 per cent. of positive leaf infections were produced.
3. It was reisolated from these artificially-produced streaks.
4. The reisolated organism was used in pure culture to inoculate sixty leaf blades and 100 per cent. of positive leaf infections were produced.
5. Fifty-nine stalks were inoculated with Organism W by means of a hypodermic syringe at different points, and all of the symptoms described at the beginning of this paper were produced.

6. Organism W was isolated from stalks naturally infected with top rot but showing no red leaf stripes.

7. One hundred leaf blades were inoculated with pure cultures of Organism W obtained as mentioned under 6, and 100 per cent. of positive leaf infections were produced.

8. Organism W was reisolated from a stalk artificially infected with top rot, by inoculation with a pure culture of Organism W, but showing no red leaf stripes.

9. This reisolated strain was used in pure culture to inoculate twenty leaf blades and ten stems—all of the leaf blades developed red stripes and all of the stems became top rot infected.

10. It was observed that stalks whose leaves had been inoculated with pure cultures of Organism W frequently developed top rot a few weeks later.

11. Adequate check inoculations were made, and throughout these yielded negative results in every case.

Final Conclusion.

Red leaf stripes and top rot are different manifestations of the same disease. Both are caused by one organism, a bacterium, which has been referred to as Organism W. The morphologic and cultural characteristics, and the systematic position of this organism, are discussed in the next section.

QUEENSLAND SHOW DATES, 1932.

Killarney: 29th and 30th January.
 Stanthorpe: 3rd to 5th February.
 Warwick: 9th to 11th February.
 Allora: 17th and 18th February.
 Oakey: 19th March.
 Goombungee: 2nd April.
 Pittsworth: 6th and 7th April.
 Chinchilla: 5th to 7th April.
 Miles: 13th and 14th April.
 Clifton: 13th and 14th April.
 Toowoomba: 18th to 21st April.
 Dalby: 27th and 28th April.
 Charleville: 4th and 5th May.
 Boonah: 4th and 5th May.
 Mitchell: 11th and 12th May.

Roma: 16th and 17th May.
 Ipswich: 17th to 20th May.
 Gin Gin: 2nd to 4th June.
 Marburg: 2nd and 3rd June.
 Bundaberg: 9th to 11th June.
 Rockhampton: 21st to 25th June.
 Mackay: 28th to 30th June.
 Rosewood: 15th and 16th July.
 Royal National: 8th to 13th August.
 Crow's Nest: 24th and 25th August.
 Wynnum: 26th and 27th August.
 Beenleigh: 16th and 17th September.
 Rocklea: 24th September.
 Nerang: 14th October.
 Cleveland: 8th and 9th July.

TO SUBSCRIBERS—IMPORTANT.

Several subscriptions have been received recently under cover of unsigned letters. Obviously, in the circumstances, it is impossible to send the journal to the subscribers concerned.

It is most important that every subscriber's name and address should be written plainly, preferably in block letters, in order to avoid mistakes in addresses and delay in despatch.

THE CATTLE-POISONING SAWFLY

(*Pterygophorus analis* Costa).

By F. H. S. ROBERTS, M.Sc., Entomological Branch.

QUEENSLAND is fortunately free of many of the more serious diseases so common among cattle in other countries, but, so far as is known, is unique in that heavy losses frequently occur through the animals eating the larvae of an insect.* The insect in question is a member of the hymenopterous family *Tenthridinidae*, or sawflies, so-called because the females possess a saw-like apparatus which is brought into use during egg-laying. The scientific name for this particular sawfly is *Pterygophorus analis*, this name having been given it by G. Costa, an Italian entomologist, in 1864.

The first reported occurrence of cattle dying through eating the larvae of this insect was in 1911, the fatalities being for a while attributed to cyanide poisoning from baits strewn about by opossum trappers. Since then losses among cattle from sawfly poisoning have been fairly frequent and in the years 1913, 1914, 1917, 1921, 1922, 1924, 1926, 1928, and 1931 were particularly severe. The fatalities are confined to the months of July, August, and September.

Mr. Henry Tryon, late Government Entomologist, investigated the problem in 1914, and during the 1926 outbreak Mr. J. Harold Smith, of this Branch, visited the Westgrove area. The observations of these investigators will be discussed throughout these notes. The writer was despatched to the Westgrove-Tooomba district during the epidemic of this year (1931). The observations here recorded, therefore, refer mainly to the conditions prevailing during the outbreaks in this area, but there is no reason to believe that they do not present an accurate estimate of the position throughout the whole of the affected country.

The Distribution of the Sawfly.

The principal food tree of the larvae of the sawfly is the silver-leaf or broad-leaf ironbark, *Eucalyptus melanophloia* F.v.M. This eucalypt has a wide distribution throughout Queensland, and it would be expected that the range of the sawfly would be fairly extensive. It probably is, but there is no information on its distribution beyond that obtained through its association with fatalities among cattle. These fatalities have been reported from the Maranoa, Warrego, and Leichhardt districts. The Maranoa district is affected probably throughout the whole of its northern areas, the southern limit being Waterhole Creek, near Surat. In the Leichhardt district the only report of fatalities comes from its south-eastern corner, a station, near Rolleston, reporting losses in 1927. In the Warrego, several holdings east of the Warrego River and extending at least 20 miles north of Augathella are concerned. The silver-leaf ironbark is dominant among the timber flora of this affected area, and it may be that there is a concentration of the insects in this area in proportion to the number of food trees present.

Life History Notes.

As with most insects, there are four distinct stages in the life history of the sawfly—namely, the adult, the egg, the larva, and the pupa.

* In a recently received copy of the 17th report of the Director of Veterinary Services and Animal Industry, Pretoria, South Africa, it is noted that the eating of live pupae of a moth *Nudaurelia cytherea* by pigs is followed by fatal results. Death is proved to be due to a toxin, which acts as a severe gastro-intestinal irritant.

The Adult.

The adult (Plate 17, Figs. 1 and 2) is a glossy blue and yellow insect, the thorax being dark-blue above and below, with yellow shoulders and scutellum, and the abdomen yellow with a series of small blue lateral spots. The legs are pale yellow except at the base, where they are dark blue. The wings are smoky with darker veins, and when at rest, folded along the insect's body, they appear black. The female may measure nearly three-quarters of an inch in length, and has black threadlike antennae (Plate 17, Fig. 2A). The male is smaller and more slender than the female, and may be readily recognised by its feathered antennae (Plate 17, Fig. 1A). There is probably only one generation a year, and the adults are to be seen in numbers soon after the summer rains, *i.e.*, about February to April. The life of the adult insect is in all probability very short, and as they are easily susceptible to low temperatures, a cool change may be responsible for the deaths of large numbers.

The Egg.

Egg-laying has been described by Tryon, who records that the egg (Plate 17, Figs. 3, 4, and 4A) is deposited by the females in the leaves of the silver-leaf ironbark, young, but well-formed leaves being preferred. When egg-laying, the female settles astride a leaf and, exerting its saw (Plate 17, Fig. 2B) cuts a cleft for each egg in the edge of the leaf. The eggs are laid side by side, and as many as twelve or more may be deposited on the one leaf. In colour the egg is a delicate pale green, and its shape is somewhat oblong. The incubation period, according to pastoralists, is about three weeks, but dry conditions may delay hatching and, if prolonged, will kill the egg.

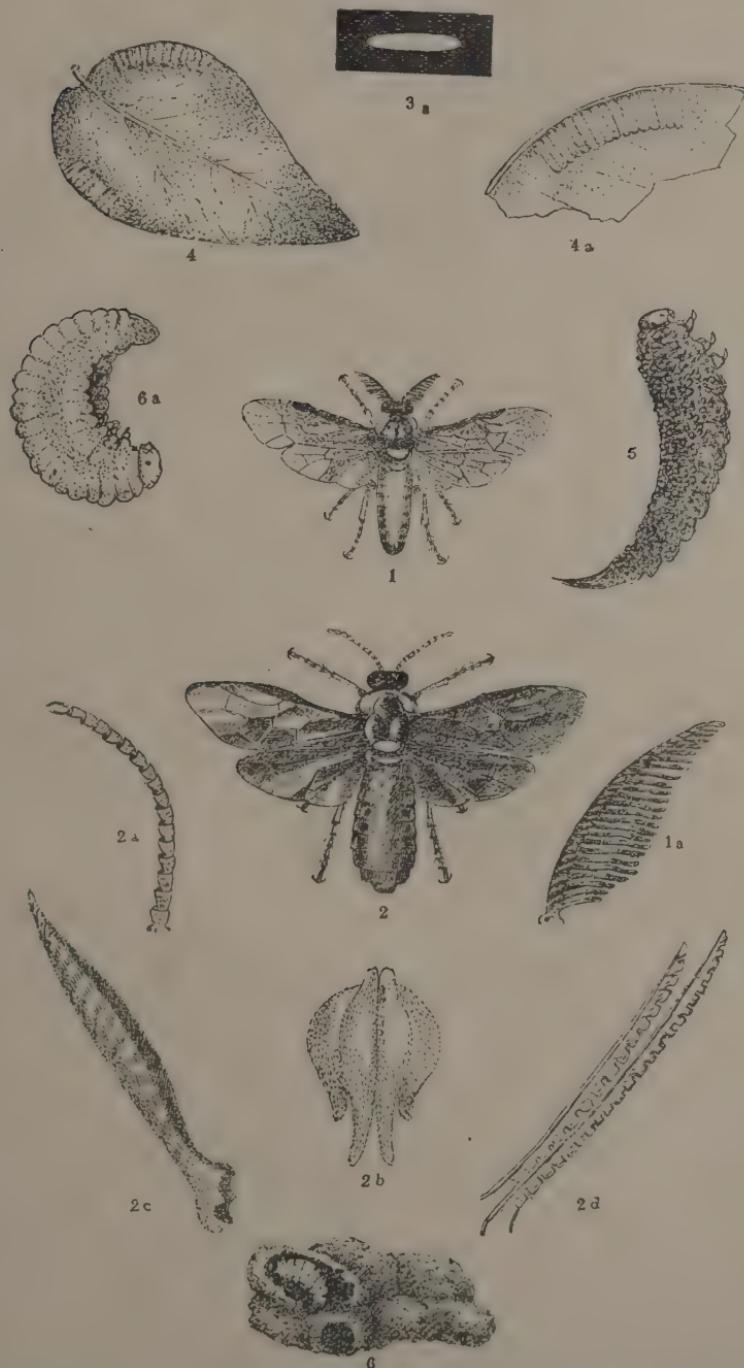
The Larva.

On hatching, the tiny larvae, congregate side by side, feed upon the edges of the leaf on which they were born. This colony formation gradually lessens as the larvae grow, the groups split up, and large larvae may frequently occur singly. In colour the larvae (Plate 17, Fig. 5) are pale green to yellowish, with reddish-yellow heads, and the body gradually tapers to a blunt point, which is surmounted by a long, black, spiky appendage. The dorsum is speckled white, the white spots being raised and very conspicuous on the darker anterior segments, and a little less so on each side of the mid-dorsal line. The anal segments are dark and somewhat reddish anteriorly. When disturbed the individual larvae elevate the hind end of the body, curving the spike in an awe-inspiring manner. They feed voraciously, and a few well-grown specimens will rapidly consume a leaf. Under normal conditions full growth is reached in the late winter and early spring, the last larval instar being recognised by the absence of the caudal spike. The larvae then descend the trees and pupate.

THE CATTLE-POISONING SAWFLY.

(Description of plate 17 page 43.)

Fig. 1. Male sawfly. Fig. 1A. Antenna of male. Fig. 2. Female sawfly. Fig. 2A. Antenna of female. Fig. 2B. External aspect of groove containing ovipositor, labia, &c. Figs. 2C and 2D. Organs forming ovipositor. Fig. 2C. Sheath or director, with joint-structure at one end. Fig. 2D. The two saws, separated. Fig. 3. The egg. Fig. 4. Ribbon of egg-cells within tissue of leaf of *Eucalyptus melanophloia* (reduced). Fig. 4A. Another view, eggs exposed. Fig. 5. Sawfly larva. Fig. 6. Larva within cocoon as formed in sandy soil (reduced). Fig. 6A. Larva, removed from cocoon prior to pupation. (After Tryon.)



Del. Hubert Jarvis.

PLATE 17.—THE CATTLE-POISONING SAWFLY (*Pterygophorus analis* Costa).

For description of plate, see page 42.

The Pupa.

Pupation occurs in the soil usually around and close to the trunk of the tree on which the larvæ have been feeding. The depth at which pupation takes place is probably dependent to a large extent on the type of soil. In sand, for example, pupæ may be found 10 inches or more below the surface. Once in the ground the larvæ construct cocoons (Plate 17, Fig. 6) from the surrounding earth, gumming the earth particles together to form an oval and compact shell. In the heavier soils the cocoons are adherent in solid blocks, whilst in sandy soil it is unusual to find any large number of cocoons occurring together, single isolated specimens being frequent. Once the cocoons are formed the larvæ pass into the prepupal stage (Plate 17, Fig. 6A), each larva lying shrunken and curved within its earthern home. This stage is thought to occupy the majority of the period spent below the earth. Eventually the pale greenish pupa is formed with the wings and other appendages visible and tightly packed against the body.

The Eating of the Larvæ by Cattle.

Heavy fatalities among cattle through eating the sawfly larvæ are always associated with a larval population far in excess of the quantity of food available. The welfare of any organism, animal or plant, is dependent upon the fact that its food supply must only be controlled and not eradicated, for if the source of food is exterminated, or nearly so, it follows that a similar fate awaits the organism. Outbreaks of such insects as army worms and grasshoppers occur in devastating proportions. Such epidemics are fortunately not frequent, and must be regarded as unusual. With the sawfly, however, a glance at the sequence of years in which the larvæ have occurred in their myriads denotes that in this case such outbreaks approach the ordinary rather than the abnormal. An explanation of these frequent outbreaks is most difficult to attempt, but it would seem that some controlling factor which may have been operating in the early days has become considerably reduced in efficiency. This controlling factor may have been opossums which consumed the eggs and larvæ along with the leaves of the trees on which they were feeding.

Observations have shown that during the years of reported losses the larvæ of the sawfly occurred so thickly on the silver-leaf ironbarks that it was usual to see confused masses of them feeding two and three tiers deep on a single leaf. Such masses may rapidly and completely defoliate a tree, and it is a common sight in the affected area to see practically every silver-leaf ironbark stripped of its leaves. As defoliation proceeds and the food supply is reduced, the larvæ commence to descend to the ground in huge numbers. This downward migration is thought to be primarily an attempt to escape the high temperatures and sunlight, exposure to which is steadily increased by the consumption of the foliage. This theory is borne out by the downward migration of larvæ from trees on which a fair amount of foliage or food still remains, but which affords little protection against the heat of the sun, and by the observation of stockowners that hot weather during the early spring is looked on with dread, as it causes the larvæ to come down in their millions. Many larvæ, unable to resist exposure any longer, simply drop from the twigs and branches on to the ground beneath. Under a large and heavily attacked tree during the heat of the day the frequency of these dropping larvæ is astonishing. Once on the ground they may

crawl to the tree trunk or else ascend such grass, weeds, and saplings as grow beneath the tree and which become bowed down with their weight. During the late afternoon, early morning, and probably during the night the migration is upward, the cool conditions encouraging the larvae in their search for food. There ensues an upward and downward migration, probably influenced by temperature conditions and sunlight which may extend at least over a period of three weeks. Eventually the larvae become too weak to attempt any further movements and die in a compact heap at the foot of the tree, generally on the sheltered side. This heap is continually being added to until the majority have died. The size of such a heap is mainly dependent upon the size of the tree; under a large ironbark, for example, the mass may measure up to 2 feet across by about a foot deep. Larvae dying on the exposed side of the trunk are rapidly dried and shrivelled up by the sun. Putrefaction sets in, and the heaps give off a most objectionable odour, eventually decaying into a black jelly-like material.

Tryon attributes the massing and subsequent death of the larvae to the onset of wet conditions at the time of pupation. Wet conditions would, no doubt, hasten decay, but that they are not the main factor of larval mortality is instanced by the formation of these putrid masses while the weather is dry. Smith is of the opinion that two factors contribute to the phenomenon—(a) Conditions unfavourable to pupation, the soil moisture content being too low to permit of the transformation of the larva to the pupa; and (b) that the larvae become starved before being sufficiently well grown to pupate successfully. Observations in August, 1931, point mainly to the last factor, *i.e.*, starvation, as being the chief cause of larval mortality, though the influence of high temperatures and sunlight must not be overlooked. During this period the host trees over large areas were completely defoliated and heaps of dead larvae occurred at the base of each stripped tree. The larvae varied tremendously in size; many were so small as to be, at the most, only a few weeks old. The percentage of mature larvae, that is, well-grown larvae without the spike, was extremely small, and pupae were similarly rare. These observations were made early in August. Well-grown larvae brought back to the laboratory did not pupate till near the end of the first week in September, and even here pupation was forced, as no more food was available. It is probable, therefore, that, had sufficient food been present to assure normal growth, pupation in numbers would not have occurred till September and October.

A search for pupae indicated that even though only 86 points of rain had fallen since April the moisture content of the soil, especially close to the tree, was sufficiently high to be evident to the touch. Larval mortality is, therefore, thought to be due to starvation, a direct result of a population far in excess of the available food, possibly aided by high temperatures and strong sunlight.

The cattle are first introduced to the taste of the insect when feeding on the larva-laden grasses beneath the trees. Once the taste is acquired their attention is directed to the large numbers available at the base of the trunk. Opinion among pastoralists is divided as to whether only the live larvae are consumed, or just the dead and putrid heaps, but there is no doubt that both the live and dead insects are ingested and that even the black, jelly-like remains do not escape. It is thought that perhaps there is a preference for the live larvae and that the decayed remains are eaten, either from habit, or else in an

endeavour to obtain larvae still alive and on the surface. Competition is high among the animals for this abnormal food; they run in mobs from tree to tree fighting and horns their way into position, licking the live larvae from the trunks, almost climbing the tree to do so, and eating great mouthfuls of the putrid heaps.

Symptoms Arising from this Insect Diet.

The onset of symptoms in cattle that have partaken of the larvae is fairly rapid. The animals become highly excited, walk with a high-stepping gait in front and a straggling gait behind, and if startled will charge fiercely. If driven with the mob the affected animals soon lag behind and eventually lie down. The animal suffers great pain, and death follows fairly rapidly. Animals have been known to die within two days of the onset of symptoms. Recovery has been known in a few cases, but generally once the animal goes down it dies. Abortion is said to be frequent among cows that have eaten the larvae but not in sufficient quantity to cause death.

With regard to post-mortem appearances, Mr. A. McGown, M.R.C.V.S., a veterinary surgeon of the Stock Branch of this Department, autopsied an animal showing signs of sawfly poisoning and found the following lesions:—"The brain and meninges highly congested, the brain being perfectly black. Spinal cord congested. Liver and gall bladder congested. All other internal organs normal with the exception of the abomasum (or fourth stomach) which was inflamed and ulcerated. In the omasum (third stomach) large quantities of the heads of the larvae were found but the body was dissolved." During the recent outbreak the majority of these observations were confirmed, but the most outstanding effect was the tremendous release of blood throughout the intestinal tract and its supporting tissues. The intestines, particularly the large intestines, were filled with blood, and the mucous membranes were highly congested. The mesenteries and peritoneum showed numerous ruptured vessels. The heart was pale and soft, and the third stomach was full of hard, dry, and compacted food. The intestinal walls were easily perforated and the body cavity contained a quantity of blood and fluid.

The Probable Cause of Death.

Fatalities among cattle from eating the sawfly larvae have been attributed to some poison present in the larvae; an overdose of eucalyptus is frequently cited, but such is hardly probable. The larvae are certainly pungent with the oil of their food tree, but as they are eaten with impunity by opossums, which ingest them with the foliage, it is not likely that cattle would be adversely affected. Cattle are also known to eat eucalypt seedlings without fatal results.

A chemical analysis of the larvae, recently made by the Agricultural Chemist, has failed to isolate any of the common poisons. Tryon suggested a ptomaine, elaborated in the decaying masses, with which Smith concurs, and it seems fairly evident from the post-mortem information that such is the case.

Ptomaine or toxin poisoning is known among cattle in other parts of the world, and is frequently associated with bone-chewing or osteophagia. In parts of South Africa, where particular attention has been given to this abnormality, it produces a serious disease known as Lamsiekte. Lamsiekte follows the chewing of bones to which rotten flesh is adherent. The direct cause of the disease is stated to be a toxin

elaborated in the putrid flesh by a specific toxicogenic saprophyte, an anaerobic bacterium reminiscent of but not identical with *Bacillus botulinus*, the organism responsible for botulism. The organism referred to is, by itself, of no pathogenic importance; but in a protein substratum, such as flesh, is able to produce a most deadly toxin, which is ingested by the cattle when chewing the rotten bones. Cattle suffering from peracute Lamsiekte exhibit symptoms, especially on post mortem, very similar to those of cattle dying from sawfly poisoning.

There is no doubt that organisms similar to those causing Lamsiekte exist here, cases of illness and deaths among human beings from "ptomaine poisoning" proving their presence. In the rotting heaps of larvae such an organism or organisms would find a most suitable substratum for the elaboration of a highly pathogenic toxin for the chemical analysis already referred to has also shown the protein content of the larvae to be very high, as much as 45.2 per cent. of the dry weight. The pathogenicity of such a toxin is said to be dependent on the protein content of the medium in which it occurs. This toxin theory would, therefore, indicate that death follows from the ingestion of the putrid remains alone, the chances of recovery being dependent upon the amount of material consumed. The eating of the live larvae by opossums without any fatal results is further evidence that the danger lies only in the rotting heaps.

Control of the Insect.

Control of the sawfly itself is fraught with difficulties, and the application of measures which have proved of value in the control of other insect pests does not appear possible.

The immense numbers of sawfly larvae which have appeared in the affected area at very frequent intervals and with such fatal results is said to be mainly due to the wholesale destruction of opossums during the last thirty years. Prior to this it was observed that these animals were very numerous indeed and that they specially favoured the young foliage of the sawfly host tree, the silver-leaf ironbark, being so numerous that at times the foliage of the tree would be rendered quite scanty. Thus whilst feeding on this tree they would destroy large numbers of the sawfly's eggs and larvae, and at the same time, by reducing the foliage, limit the opportunities for egg-laying. There is no doubt that these marsupials do destroy the larvae of the insect, for an examination of the stomachs of several animals obtained by Mr. R. C. Lethbridge, of Forest Vale, Mitchell, from the sawfly area in August, 1928, and submitted by Mr. J. Bowen, District Inspector of Stock, Roma, to the Chief Entomologist, Mr. Robert Veitch, showed large numbers of larvae to be present and in process of digestion. In connection with this known feeding habit of opossums it is interesting to note that a sanctuary of 316 square miles has been declared on adjoining portions of Westgrove and Warrinilla Stations. Unfortunately, there is little evidence that the opossums are increasing to any large extent on this sanctuary, and many years must elapse before they may possibly be again regarded as a controlling factor.

Birds are by no means plentiful throughout this ironbark country, but many of the insectivorous species are represented, and it might be expected that they would exert some measure of control. The larvae are apparently distasteful, for there is no evidence that the birds are even interested in the huge numbers exposed.

Destruction of the silver-leaf ironbark, by ringbarking, as recommended by Tryon, strikes a hopeful note. Unfortunately these trees form the dominant timber flora of the greater portion of the district, and the cost of ringbarking would be very high. On some of the smaller holdings ringbarking has been successfully accomplished, but on the larger stations with areas of 500 or more square miles, financial difficulties would arise. Smith's recommendation in 1926 that only a small area on each holding be rung and maintained for emergency purposes does, however, appear quite feasible.

The application of deterrent sprays and mixtures to repel the cattle from the dead larvae is quite impracticable, as is also the use of any other means of preventing access. One has only to visit the district during an epidemic to realise this.

Direct biological control by means of parasites may be possible, but is not likely. Tryon bred out a small Tachinid fly parasite, and many of the pupae are destroyed by fungi, but the utilisation of native parasites for the control of an indigenous species of insect is not likely to be productive of beneficial results. The only possibility of biological control by means of parasites would be in the discovery and introduction of such parasites from other countries—a work fraught with difficulties and too uncertain to be undertaken except as a last hope.

Why the Cattle Eat the Larvae and a Suggested Method for Prevention.

The idea that this depraved appetite among the cattle is due to some diet deficiency is not new. Both Tryon and Smith emphasise it, and in the departmental correspondence it is frequently referred to. The existence of such a diet deficiency among the cattle of at least the greater portion, if not the whole, of the infested district is supported by a considerable amount of evidence. In the first place the soil is to a great extent sandy and productive of little highly nutritious grass. The cattle chew bones and lick the clay exposed in creeks and water-courses, sure signs of an unbalanced diet. Further evidence is to be found in the report that cattle brought in from outside areas do not manifest any interest in the larvae until they have been on the holding for some time.

It has been said that the animal's craving is for salt, and that this craving is satisfied by eating the larvae, which some observers affirm have a distinctly salty taste. The chlorine content of the larvae is, according to analysis, not particularly high, however, being about .717 per cent. of the dry weight. Salt licks, that is, rock salt alone, have been advocated and reported useful, but the ineffectiveness of rock salt is shown by recent losses on one of the properties visited. Here 1,700 head were on agistment and had been on rock salt for some time prior to the outbreak, but it did not prevent the cattle eating the larvae to such an extent that 350 head were lost before they could be shifted.

Referring once more to Lamsiekte, it has been demonstrated that bone-chewing, or osteophagia, is the indirect cause of the disease. The cattle are craving for some substance, and this craving is satisfied by chewing bones. Sometimes the craving becomes so acute that the animals will eat all sorts of rubbish in an attempt to satisfy it. Such acute craving is known as allotriophagia. The South African authorities determined by a systematic analysis of the grasses and soils that the animals were not obtaining with their natural food sufficient phosphorus for their requirements, and by feeding bonemeal, which is rich in

phosphorus, were able to make up this deficiency and prevent craving for and chewing of bones. Thus by means of bonemeal Lamsiekte has been controlled.

As already stated, the cattle in the sawfly area are addicted to bone-chewing, a sure sign of a phosphorus deficiency, and it is suggested that this osteophagia during the dry winter months, when the nutritive value of the roughage is very low, develops into a type of allotriophagia, and to satisfy this acute craving the cattle eat the sawfly larvae.

In addition, the Agricultural Chemist states that the analysis of a large number of Queensland grasses, especially in the matured stage, i.e., as roughage, shows a low phosphoric acid content. Furthermore, that in samples of spear grass so far examined—spear grass is one of the principal grasses of the affected district—the average phosphoric acid content is particularly low. Moreover, grass samples received from different districts in Queensland where bone-chewing occurs have, upon analysis, always shown a low percentage of phosphorus.

As further evidence that a phosphorus deficiency is the cause of such an abnormal appetite, Westgrove Station used a phosphate lick with excellent results during the 1931 outbreak. This property, which carries several thousand head of cattle, has been one of the most consistent and heaviest losers through the sawfly. A phosphate lick has been in use for some time now, and its value became apparent this year when only twelve head died, most of them old cows, in a small paddock in which no lick had been placed. The larvae were just as thick here as they were on a neighbouring property where a 20 per cent. loss occurred in 1,700 head of stock.

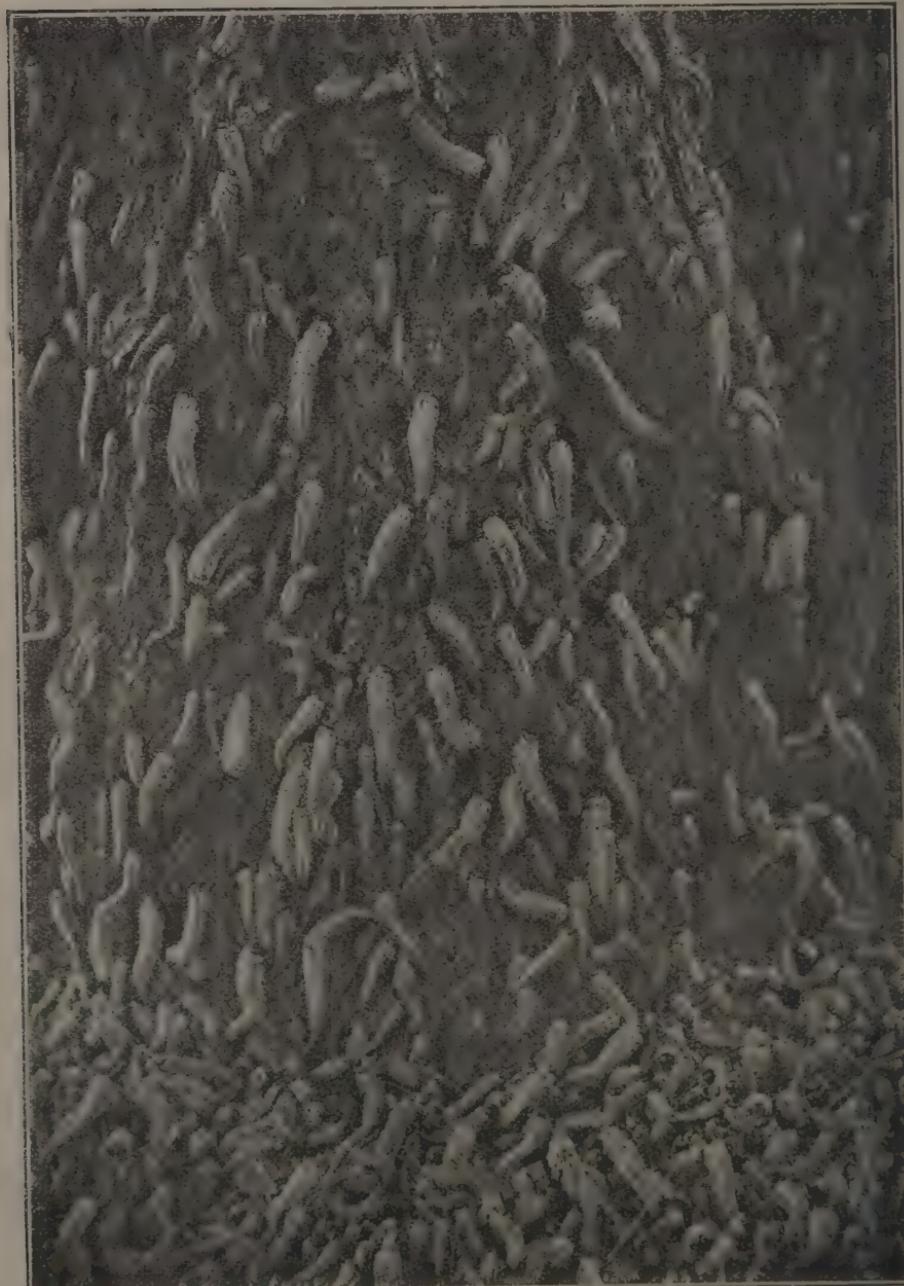
It has been said that the use of licks is impracticable over large tracts of country. That this is not so is proved by their use on Westgrove. The lick is placed out in troughs sheltered to prevent waste from rain and usually situated at some spot in the paddock frequented by the cattle.

On Westgrove the formula in use is 100 lb. coarse salt, 30 lb. bonemeal, and 30 lb. Nauru phosphate. The Agricultural Chemist of this Department, however, points out that Nauru phosphate is richer in phosphorus than bonemeal, and is cheaper. He accordingly suggests a lick composed of coarse salt and Nauru phosphate in the proportions of one of salt to two of the phosphate. In order to get cattle to take this mixture it may be necessary at first to include some linseed meal or bonemeal. It is necessary to have the lick present throughout the year. If brought into use just prior to a sawfly outbreak little benefit may be expected. A phosphate lick has other advantages, for it has been shown to promote increased beef production, increased milk yield, and a more rapid growth of young cattle.

Although the weight of the evidence given above points to a phosphate deficiency among the cattle, it has yet to be demonstrated that the grasses of the affected district have a low phosphate content. This aspect is now under investigation by the Agricultural Chemist.

Host Plants of the Sawfly.

The information available as to the several species of trees on which the sawfly has been found feeding is rather confusing. The larva has been found on the following species:—*Eucalyptus melanophloia*



Del. Hubert Jarvis.]

PLATE 18. —THE CATTLE-POISONING SAWFLY (*Pterygophorus analis* COSTA).
Larval Stage. (After Tryon).

(silver-leaf or broad-leaf ironbark), *E. siderophloia* var. *glaucia* (black ironbark), *E. crebra* ? (narrow-leaf ironbark), *E. rostrata* ? (red gum), *E. populifolia* (bimble box), *E. hemiphloia* ? (gum-topped box), *E. corymbosa* (bloodwood), *Acacia excelsa* (ironwood), and *Angophora intermedia* (apple). The main host tree is undoubtedly the silver-leaf ironbark and it is most probable that eggs are not deposited on any of the other species except, perhaps, *E. siderophloia* and *E. crebra*. The identification of this second species is uncertain, and it is possible that it may have been confused with *E. siderophloia*. That larvae have been observed on such a wide range of hosts is probably due to the fact that larvae from stripped ironbarks will ascend and attempt to feed on any plant in the vicinity.

Summary.

1. Heavy losses among cattle occur frequently through eating the larvae of the sawfly, *Pterygophorus analis*. These losses were particularly severe in the years 1911, 1913, 1914, 1917, 1921, 1922, 1924, 1926, 1928, and 1931.

2. Fatalities are confined to the Northern Maranoa and to portions of the adjacent Leichhardt and Warrégo districts. The range of the insect itself is possibly much wider than that recorded in its association with cattle.

3. The sawfly has probably only one generation a year, the flight period of the adults being during the months of February to April. The eggs take about three weeks to hatch and are laid mainly, if not solely, on *E. melanophloia*, the silver-leaf ironbark. The larvae are present throughout the winter, pupating in the spring.

4. Cattle fatalities are associated with a larval population far in excess of the available food. Starvation, probably aided by high temperatures and sunlight, causes the majority of the larvae to die in large heaps at the base of the tree.

5. The cattle eat these larvae with fatal results. The cause of death is thought to be a ptomaine or toxin elaborated by a bacterium in these decaying heaps. It is suggested that fatal results follow the ingestion of this rotting material only, and that the live larvae alone produce no ill effects.

6. Control of the insect does not seem feasible at the present time. Opossums were probably the main controlling factor during the years prior to the first outbreaks, and the balance of nature has been destroyed by the tremendous decrease in the numbers of these animals. A sanctuary of 316 square miles on Westgrove and Warrimilla has been declared in order to give the animals a chance to increase. Attempted control by parasites would mean a vast amount of work with very uncertain results. Mechanical methods of control are regarded as impracticable.

7. Evidence is produced to show that cattle eat the larvae because their diet is deficient in some substance. A comparison of this disease with the South African Lambsiekte indicates that this deficiency is in phosphorus. The successful use of phosphate licks on Westgrove goes a long way to confirm this theory. The final confirmation is to be found in an analysis of the grasses, and this is at present being investigated by the Agricultural Chemist of the Department of Agriculture and Stock. The phosphorus is given to the cattle in the form of a lick, which must be supplied throughout the year and not during the epidemic only. Formulae for the preparation of this lick are given.

9. The principal food tree of the sawfly is undoubtedly the silver-leaf ironbark, but the larvae, urged by starvation, may be found on other trees, principally eucalypts.

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ECONOMY IN TRUCK FUEL.

It is an axiom in modern commerce that quality and price go hand in hand. If quality is desired by a purchaser, it necessarily follows that an adequate price must be paid. If lower prices are demanded by a purchaser, then some sacrifice must be made in quality to permit the low price quotation. Sometimes articles of equal quality are offered for sale at slightly different prices. Generally speaking, this is made possible by the fact that the seller at the lower price is enabled to do so by his large volume of business. These remarks apply to most commodities which are sold and they apply particularly to petrol. It definitely costs more to produce petrol of high quality than petrol of mediocre or low quality. Consequently, it is necessary to sell high quality petrol at prices slightly higher than low quality petrol. Low quality petrol might represent a saving in initial cost, but let us consider the relative values actually received from high quality petrol and low quality petrol. It will clearly be seen that a small saving in initial petrol costs is more than offset by incidental expenses.

The quality of petrol has a very direct bearing on the amount of power which is obtained from an engine. Low quality fuels produce detonation, either silent or audible, in the internal combustion engine, and detonation is a potent force in preventing the development of full power. This has recently been verified by tests which show an increase of 20 per cent. in the power production of an engine obtained by replacing a low quality fuel with a high quality fuel. This 20 per cent. increase was due entirely to the elimination of detonation.

Full power production means the maximum amount of work from a gallon of petrol and maximum miles per gallon. It means top gear hill climbing with reduction of petrol-consuming second gear work.

High quality in petrols means that all of the petrol is readily vaporised by the carburettor. Inferior quality means that part of the petrol is not so vaporised and passes to the engine in a liquid condition in the form of small droplets. Experience has shown that these liquid droplets are not completely burned during combustion; some of them pass out through the exhaust and constitute wastage of petrol. Thus, for a second reason, high quality goes hand in hand with maximum miles per gallon.

Some of these liquid droplets have another action which must not be forgotten. This action is that they mix with the oil on the cylinder wall and, with circulation of the oil, find their way to the crankcase, and mix with the engine oil lubricant. This admixture with the crankcase oil destroys the lubricating value of the latter, and so leads to excessive wear of the moving parts of the engine.

This wear of the engine is an ever present enemy to the user of petrol of inferior quality. Wear and tear on the engine does not make itself felt until the accumulated result is sufficient to involve heavy repair bills or a large reduction in the resale value of the unit. Cheap petrol may appear to represent a saving—in most cases it represents future losses very much greater than the initial cost saved.

FARMERS' SHEEP AND WOOL.

By J. CAREW, Senior Instructor in Sheep and Wool.

[Continued from the September issue, 1931.]

PART VII.

This is the seventh article of a series planned for the purpose of supplying information sought from time to time by readers interested in sheep and wool; and also with the hope of stimulating interest in sheep raising in Queensland on relatively small holdings.

CONSERVATION OF FODDER.

IN districts where crops can be grown successfully, either in summer or winter, it is advisable to grow them.

There are many crops suitable for sheep feed, when conserved, such as wheat or oats for autumn sowing and panicum or Sudan grass for spring and summer sowing.

If in a good season grass were cut and stacked on the property in convenient feeding places, it would prove a useful roughage that would keep the sheep going for some time, with the addition of a concentrated food such as sheep cubes, maize, or linseed nuts—at the rate of a few ounces per day. Large numbers of sheep may thus be maintained at a minimum of cost.

SHEEP FEEDING.

A ration for full-grown dry sheep when in normal or fair store condition is based on their actual live weight, allowing 3 lb. of suitable food per 100 lb. live weight.

If the sheep are healthy and in fair store condition they can be maintained on about 8 oz. of suitable food every day, provided they have free access to good water.

The following should form a suitable ration per head per week, which can be given in due proportion as a daily ration:—

28	oz. lucerne chaff.
12	oz. finely cracked maize.
12	oz. bran.
3	oz. finely ground Nauru phosphate.
1½	oz. coarse crude salt (containing no large lumps).

56½ oz. total for one sheep for one week.

If the price of these ingredients at per ton on the holding is—lucerne chaff £10, ground maize, £10, bran £15, Nauru phosphate £10, and salt £5, the bare cost of feeding will be four and one-tenth pence (4s. 0 1/10d.) per head per week.



PLATE 19.—WHEATEN HAY STACKS ON RETRO STATION.



PLATE 20.—HOLDING THE MOB.
A Retro flock awaiting their daily ration and held in check by their sagacious guard.

Should roughage exist in the paddock, the lucerne chaff can be reduced and the quantity of Nauru phosphate increased in order to deter the sheep from eating too freely of the bran and maize meal. This ration is useful only for trough feeding. The quantity of troughing necessary to feed sheep should allow for, approximately, 2 ft. for rams, 8 in. for each ewe, and 4 in. for lambs, with access to both sides of the trough. For feeding without troughs, lucerne hay, sheep cubes, sheep nuts, or whole maize may be used. The maize should be soaked in water for twelve hours. If the grain is allowed to remain in the wet sack for at least another twelve hours it would be an advantage.

If troughs are not available the rations may be broadcast at some suitable place, preferably a clay pan near the watering places.

Lucerne hay is the most suitable among the hays, unless some other variety is available on the holding. It is added to make up the bulk material and possesses nearly all the elements required in the ration.

Should there be sufficient roughage available in the paddock, then whole maize may be used at the rate of 2 to 3 oz. per head per day; but better still is the use of maize one day and sheep cubes or nuts the next. If both are mixed and fed together, some sheep may take all maize and others all the cubes, none getting the proper balance. When this system of feeding is adopted, the sheep should have free access to a good stock lick.

When feeding scrub or shrubs, to give the quantity of roughage necessary it is very important to keep a good lick rich in phosphates up to the sheep. According to analysis, all the edible shrubs ordinarily available, although rich enough in lime, are very deficient in phosphoric acid. These two ingredients should be present in fairly even proportion in order to maintain a balance.

Growing Wheat and Making Hay.

Mr. P. C. Allan, of Retro Station, in the Capella district, commenced growing wheat in 1910, and in 1915 had an accumulation of 630 tons. When conditions became so dry that feeding had to be resorted to, continuing practically throughout the whole of 1916, during which time this hay was cut into chaff, it proved to be a valuable asset. Again, in 1919, wheaten hay was grown and continued until 1925, during which period 160 acres were kept under cultivation. The following table gives a brief summary of the results:—

Year.	Area.	Tons of Hay Saved.	Cost per Year.
1919	160	120	£ 286 4 10
1920	160	170	305 4 3
1921	160	420	628 7 2
1922	160	120	584 1 5
1923	160	100	502 18 2
1924	160	160	329 17 3
1925	160	Nil	164 19 6

Thus in seven years six crops were harvested, producing 1,090 tons of good quality hay at a cost of £2,682 9s. 7d., allowing £117 5s. for insurance, or £2 7s. 4½d. per ton in the stack.

The cost of cutting it into chaff, without bags, amounted to 14s. 1d. per ton. Thus, allowing for all expenses and depreciation, the cost per ton of the chaff ready for feeding may be reckoned at approximately £3 5s.

Method of Feeding.

While the feed was being put into the troughs the sheep were held in check by the dog. The method of feeding was as follows:—

The wheaten chaff was taken as at average bag weight and placed in the troughs. The maize and bran were placed on the top and worked in. When the feed was all ready the sheep were allowed to come forward to the feeding troughs, as seen in the photograph.



PLATE 21.—RETRO SHEEP AT THE FEEDING TROUGH.

1 JAN., 1932.]

QUEENSLAND AGRICULTURAL JOURNAL.

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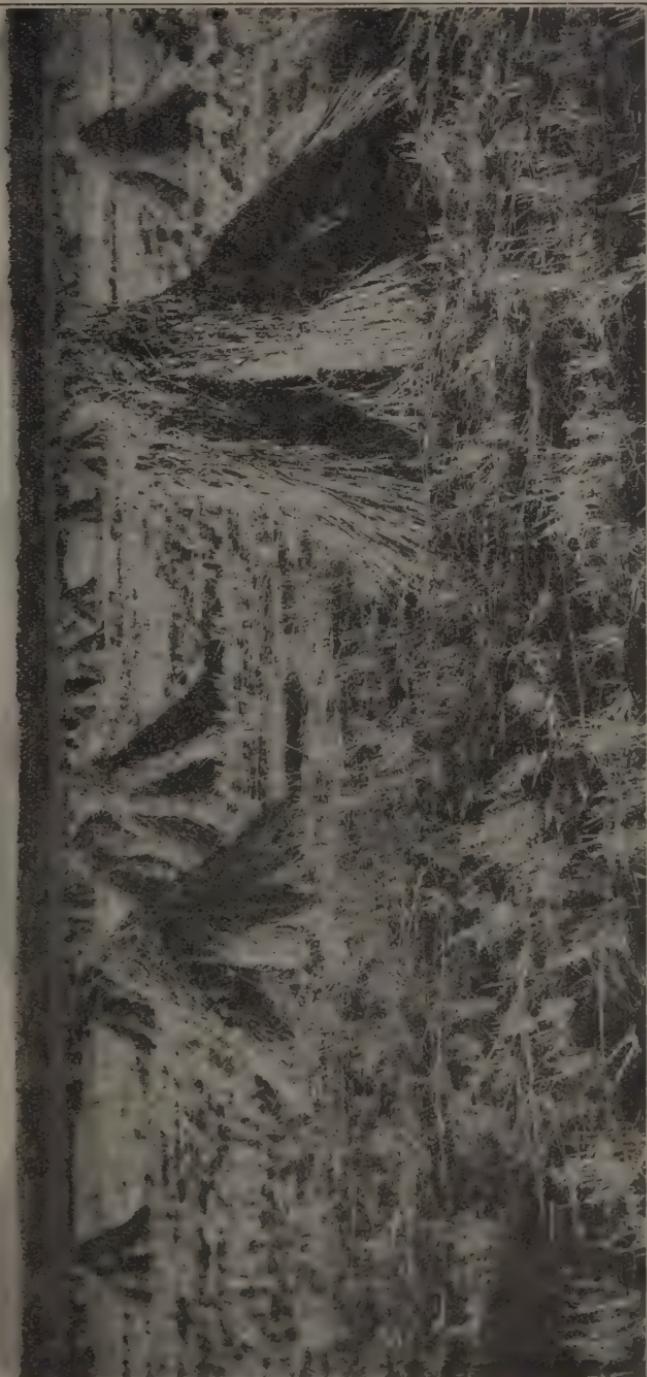


PLATE 22.—THE HARVEST—A WHEAT FIELD ON RETRO STATION.

The Cost.

Feeding 10,000 with home-grown wheaten chaff at £3 5s. per ton and bought bran and maize-meal, also wages for feeding, erecting troughing, petrol, oil, cost of licks, from the beginning of April to the end of October, when the sheep were sent away, made a total of 7s. 10d. per head. The bran and maize-meal were landed at a cost of 3.54d. per head per week for a daily ration of 2 oz. bran and meal and 1 lb. wheaten chaff. The sheep were allowed free access to pasture and water. Mustering was practised in the beginning, but as a regular feeding time was instituted and the troughing placed close to the watering place, it was found unnecessary to continue it. The ewes lambed during the time they were on feeding rations, and 54.3 per cent. of lambs were shorn. Many of the ewes were aged, but losses were normal. During this year, 1928, an area of 150 acres was sown. The first ploughing was commenced in November, 1927, and the second ploughing was carried out during January and February, 1928, and all the land harrowed after the second ploughing. The seed was sown in May, but did not germinate until after June rainfall of 1.29 in. The only other rainfall during growth was 22 points in July. The rainfall during the year from January to the time of harvesting was as follows:—

April	..	..	3.27 in.
May	..	..	6 points
June	..	..	1.29 in.
July	..	..	22 points

The April rain gave the subsoil a good soaking, but the surface soil had dried out by the time the seed was sown, which accounted for its not germinating when sown.

The rain in June was sufficient to soak the soil down to the subsoil, which was still moist after the April rains.



PLATE 23.

This stack of Sudan grass proved a valuable dry-time standby.

This moisture was conserved by having the surface soil worked in planting and harrowing, and unquestionably the success of this crop, with a rainfall during growth of only 1.57 in., was a result of early ploughing and the April rains being allowed to soak in and the soil not turned over again, but having the surface harrowed.

The following expenses were incurred in producing, harvesting, and stacking in the shed:—

			£	s.	d.
Two ploughings at £1 6s. 9d. per acre	..	..	201	3	2
Wheat seed, $\frac{1}{2}$ bushel per acre	..	..	39	0	0
Harvesting, £1 10s. 9d. per acre, or £1 1s. 3d. per ton	..	..	231	12	6
Cost per ton in stack amounted to ..	..	..	2	7	3

The equipment used consisted of two three-furrow disc ploughs, one three-piece set of harrows, one McKay six-furrow cultivator, two reapers and binders, one engine (9 horse-power), one chaffcutter and double bagger, hay forks, two motor lorries, two hay wagons, 4,445 feet bag troughing, two six-horse teams of horses, mostly all brood mares, that do all station work.

The shed held about 225 tons of hay conserved during the season.

Mr. Allan has been so successful in the production of wheat that he considers it a wise policy to continue. Still, it is not the only crop produced as shown in the photograph where a very successful crop of Sudan grass was saved.



PLATE 24.—A WELL-FILLED HAY SHED ON RETRO.

As a team of horses must be kept on all stations, it stands to reason that they would otherwise be idle for a considerable portion of their time; therefore they are kept going in the cultivation paddock, ploughing, harrowing, and harvesting when not on other work, and in this way assist in securing feed for themselves as well as a standby for other stock. Including the sheep as in the figures quoted, working horses and milking cows were included as well as the cost of all wages and rations. The figures prove the success of the undertaking, and should act as an incentive to other pastoralists to do likewise.

[TO BE CONTINUED].

FISH MEAL IN ANIMAL FEEDING.

The United States Bureau of Fisheries has published a document entitled, "Fish Meal in Animal Feeding, with Bibliography," by John Ruel Manning, Technologist of the United States Bureau of Fisheries. When issued, this publication may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D.C., at a very nominal price; and in quantity it may be secured at a reduced rate.

This document should be of interest not only to persons in the fishery industries and producers of fish meals and shell-fish meals, but also to bio-chemists and other research workers in this field, and to animal feeders and those interested in animal nutrition in general. It contains as complete a bibliography as could be assembled, together with non-critical comments and abstracts of the references contained therein. The general nutritive properties of fish meal are discussed in detail. The results of experimental feeding of farm animals, as well as the work done with laboratory animals, are included in this document. The methods of feeding fish meal, and the proportions or percentages of fish meal in the rations of various farm animals, recommended by the best authorities, and many other principles of practice of vital interest to the farmer, are set forth.

THE VALUE OF BIRD LIFE.

By D. WILSON, Ranger, Animals and Birds Act.*

A RECENT survey by the Government of the United States of America has shown that the annual loss due to the destruction of bird life there is enormous.

What the annual loss is to Australia cannot be computed easily, but it also must amount to a huge sum annually.

The Ibis.

An idea may be gained as to the value of bird life when, for instance, in the Riverina in New South Wales there are many rookeries of the ibis. One of these rookeries was estimated to be inhabited by about 240,000 birds. Examination of the crop contents of some of these birds showed that each contained about 2,000 young grasshoppers, a pest that devours pastures. A simple calculation shows that this colony of birds alone could account for 480,000,000 grasshoppers each day. Think for a moment what damage this lot of insects could do if left alone by their avian enemies.

Orchardists are beginning to recognise that bird life must be maintained for the security of their crops, and that the work performed by the feathered friends of man in the protection of our orchards is of direct benefit and is a distinct factor in rural economy.

The Silver-Eye.

The little silver-eye, one of the most valued birds in clearing the fruit trees of scale, aphis, as well as predatory insects, is often looked upon as a pest, simply because it helps itself to a little fruit after keeping the trees free of disease for eleven months of the year. Think of the damage from disease that would result were it not for the destruction of flies by our flycatchers, also the crows, through their activities as natural scavengers. Putrifying carcasses of animals that have died during a drought and otherwise form a breeding ground for many noxious flies, which are either carriers of disease or infest sheep, thereby reducing the output of wool and of mutton; and the insectivorous birds, feeding on flies in their maggot stage, are the most important influences in checking their further propagation and minimising the incidence of infestation.

Shag.

The cormorant, or shag, often comes in for its share of fierce abuse and, at times, gunfire, because it lives on fish. Men have been killing shags in many parts of Australia for no other reason than that they are fish eaters. Usually those who are so ruthless in their attacks on this big bird have little, if any, first-hand information as to the kind of fish they eat. The shag feeds chiefly on eels, catfish, and toad fish, each of which are great consumers of edible fish spawn. In irrigation channels, where yabbies or crayfish do enormous damage to the banks, the shag is particularly useful in keeping their numbers down.

In New Zealand, shags are listed among protected birds on account of the amount of good work done by them in destroying the enemies of trout and salmon.

In Victoria, trout have been bred for over thirty years by the Anglers' Club, and in that period shags have been shot regularly by members of the club, but trout have never been found in the birds' crops.

Deep sea fishermen on the Australian coast state that they have often seen shags with eels up to 3 feet long. An eel that size would destroy more fish spawn in twenty-four hours than a shag could eat in one year. They also seem to eat large quantities of toad fish, which destroys more spawn than any other fish.

A Gardener's Friend.

The silver-eye, already mentioned, is one of the most useful birds that we have; it is also known as the cherry-picker, white-eye, blightbird, and wax-eye. Rose growers should always welcome the arrival of this little bird in their gardens, for it does much to clear their plants of the green fly, and to watch these pretty

* From a radio lecture from 4QG.

birds passing along the branches and picking off the aphis, scale, and other pests that, if left alone, would soon ruin both gardens and orchards, is much more agreeable than spraying.

The Swallow.

The swallow gets practically the whole of its food from the air, feeding on insects while on the wing, devouring thousands a day and making life more pleasant when we consider how many more pests we would have to contend with if there were no birds like them and fantails, pec-wees, and hundreds of others that live on insects.

The Raven.

The Australian raven, often called the crow, has a bad reputation with farmers and sheep-owners. In a large flock of lambing ewes, very often a number of lambs are stillborn, and what can be more natural, when a crow is making a meal of a new-born lamb, for any person to jump to the conclusion that murder has been committed.

Sheep-owners all over Australia have the blowfly pest to contend with, and in spite of precautionary measures, it has considerably increased during the past ten years. Both the sheep blowfly and the common blowfly attack living sheep, and both species breed in very large numbers on dead animals.

The loss to Australia caused by the blowfly pest is about £4,000,000 annually. It is obvious therefore, that if we destroy the carrion-eating birds, the pest, left to breed unchecked, would surely be responsible for still greater loss.

While it would be a big thing to say that, by encouraging the crow, the blowfly would be exterminated, yet if the bird got the protection it well merits the loss caused by the blowfly would substantially decrease.

Ravens also take toll of young rabbits, and during the summer months greedily devour thousands of grasshoppers and caterpillars. If the farmers and graziers would but realise that this much-abused bird is not the black devil that he is supposed to be, and study the feeding habits of the raven or crow, they would perhaps then be able to assess the amount of good as far outweighing any evil with which they are often quite unjustly debited.

The Starling.

The starling is a most useful bird in cattle and sheep country, being very fond of ticks, also grasshoppers and caterpillars. If you take particular notice when in the country, large flocks of these birds will be seen feeding on the ground, cleaning up the ticks that infest both cattle and sheep. What value are these birds that save the country so many thousands a year? Just take note of the man with the gun and hear what he has to say; then look over his stock, his milking cows particularly, covered with ticks, and dog poor from tick worry. He does not realise that by shooting all the bird life about the place he is simply an active agent in the breeding of these and other pests, and that if left alone the birds would keep his stock and pastures free from insect vermin and prevent enormous economic loss.

APPEARANCE COUNTS.

There can be little doubt that the appeal to the eye is a force that always counts. Appearance may not be everything, but it is a great deal, and anything which conveys a good impression to the beholder is likely to hold his gaze; whereas another thing—just as good, perhaps, but spoiled by a bad superficial appearance—is likely to be passed over because it offends his eye or fails to impress him in regard to its actual value. This is very much the case with live animals when exhibited for sale. There is no need, of course, if you have a sheep or a pig or a bullock for sale, to titivate it up as if it were going to a show, where it would be subjected to the close scrutiny of very particular judges, but a little time spent on making the animal look respectable is by no means wasted. The man who sends in a load of pigs to market in a dirty cart without straw presents to the would-be purchaser a sight that is sufficient to repel him at once. When animals are sent to market, as they not infrequently are, covered with mud or other filth, just as they come out of the field or the yard, they are handicapped at least to some extent. They may be good, but they look bad, and the price they fetch is, on that account, invariably affected.

MOISTURE TESTING IN BUTTER FACTORIES.

By O. ST. J. KENT.

QUEENSLAND, as a primary producing State, produces and exports large quantities of dairy products each year. Some idea of the size of the industry is gleaned from the production figures for the year 1930.

During that period 87,554,244 lb. of butter were produced, with an estimated value of £5,902,091. Of this amount 59,710,224 lb., or 68 per cent. of the total produced, were exported to the overseas markets, representing the sum of £4,025,109.

With such a large production it is obvious that even the smallest increase in the price per cwt. received means a considerable sum of money to Queensland. It is equally obvious that any steps taken in the direction of economical control of the manufacture, with a resultant increase in efficiency and production, will mean added wealth to the State.

Although it is impossible to control the market price of butter overseas, it is possible to control the methods relating to efficiency in manufacture.

One of the simplest ways of effecting economy in the manufacture of butter is by carefully controlling the moisture content of the butter.

One numerical example will show what could be done. The average moisture content of butter produced in Queensland, we will take as 14 per cent. If the average could be lifted to 15 per cent. it would mean an additional £59,000 to the State.

Unfortunately butter is not bought on its chemical analysis and, so far as it is known, the factory which produces a butter with an average of 14 per cent. moisture does not receive any more for its product than a factory producing a 15 per cent. moisture butter of equal quality.

The standard for butter in Queensland, as in other leading butter-producing countries, is 16 per cent. moisture as the maximum. This means that the nearer the 16 per cent. mark can be approached without jeopardising the quality of the butter the more profitable it is going to be for the factory.

In Australia the question of moisture control has been forcibly brought to the notice of all factories by the recent regulation which necessitates the testing of every churn of butter for export.

It is generally realised now that the benefits to be derived from a knowledge of the moisture content of butter greatly off-set any inconvenience caused by the carrying out of the test.

As a matter of fact, the moisture test of butter is one of the necessary steps in the production of a standard product, and it should be the aim of every factory to produce an article of standard quality and composition.

The test is really a very simple one, but unless certain precautions are taken a substantial error can occur.

It is the purpose of this paper therefore to discuss the methods in use and to point out the sources of error.

The Moisture Test.

Briefly the moisture test for butter is as follows:—Ten grammes of butter are weighed into a tared metal cup, heated over a flame or hot plate to expel the water, cooled, and then weighed again.

The loss in weight gives the moisture in the butter taken.

Types of Balance (or Scales).

The type of balance to be used needs consideration. There are at least six different types of "scales" in use in the various factories. A number of these are not sufficiently accurate and should not be used.

There are three main types in use:—

- (a) Direct reading one-pan type;
- (b) The chemical balance;
- (c) The torsion balance.

The most common type in use is the type (a). On these "scales" the moisture percentage is read off directly on the graduated beam. There is only one pan. The second type is the chemical balance. This type has two pans and needs a simple calculation for determining the result. There is a quick method for use with this balance, which will be described later. (See end of this article.)

The third type is known as the torsion balance. This type has two pans, but is quite distinct from the chemical balance.

The direct percentage is also read off on a graduated beam by sliding an attached weight or rider along the beam.

The three balances referred to above are all capable of giving very accurate and reliable results if proper care is taken in carrying out the test.

Each type has its advantages. The chemical balance, for example, can be used for any other scientific work where weighing is necessary. The use of the other types is more or less restricted to the moisture test in butter.

Of the three, the torsion balance seems to be the least likely to be put out of action with factory use.

Choice of Position in Factory.

Whatever balance (or scales) is used it is necessary to choose a suitable place in the factory for it. It must be placed on a rigid bench, table, or stand, which is not subject to vibration by the machinery. It must not be placed in a position where it is affected by draughts of air, and it should be protected from water and steam.

A glass case or a cupboard with glass doors is a most suitable container.

Provision should be made for light, and the space devoted for the purpose should be ample for the operator to work in comfort.

A tendency in some factories is to place the moisture-testing outfit in the most awkward corners, and in some cases it is so surrounded by boxes or cans that the light is very bad and the working conditions uncomfortable.

Taking the Sample.

In all chemical work where an analysis is to be carried out, the most important part of the process is the taking of a sample.

Unless a sample is taken correctly it is useless to expect a correct result.

Great care then must be taken in sampling, and a sample representative of all the butter in the churn should be obtained.

The butter at one end of a churn is not always the same as the butter at the other end. It is necessary, therefore, to take at least three portions of butter from each churn for a test. One portion is taken from the middle and one from each end of the churn.

In taking these portions a trier or spatula may be used, but the point to be observed here is that the surface of the butter with its adhering free moisture should be first of all removed before sampling. The sample may be taken from the churn itself or from the barrow, according to the wish of the butter-maker.

Preparation of Sample.

Having obtained the sample, there are a number of ways in which the butter may be prepared before weighing.

(a) The butter may be placed in a dry glass jar with a lid and warmed in water at a temperature of 100 deg. Fahr. until it is melted. The butter is then vigorously shaken so as to produce a homogeneous creamy mass. If this method is followed, care should be taken to see that all the butter melts before weighing.

It is quite easy to get an incorrect sample by incomplete melting and mixing.

Overheating will cause a separation of the casein from the fat, and in this condition it is difficult to weigh out a portion that is truly representative of the whole.

(b) The method which I recommend for factory use is not to melt the butter. The three portions representing the sample should be placed on a piece of glass plate or glazed tile about 8 inches square, and quickly and thoroughly mixed up with the aid of a bone spatula or piece of flat wood.

The reason for recommending the non-melting method is that for factory work this method is just as accurate as the other, occupies less time (a big factor in factory operations), and is not so liable to give errors due to incomplete mixing.

Weighing the Sample.

The weighing should be carried out immediately after the sample is prepared. If it is not convenient to weigh immediately, the sample should be placed in a dry bottle or tin, each with a close-fitting lid.

The first point to watch in weighing is that the balance is adjusted and swinging properly. Next the balance must be brought to rest (i.e., to the non-swinging position) by means of the lever or handle provided, before putting the ten grammes of butter into the aluminium cup.

In using any balance the weights should not be handled with the fingers. A pair of forceps (or pincers) should be used.

Weights should never be added to or taken from a balance whilst it is swinging.

The butter should be transferred to the cup by means of a spatula, or more preferably two spatulas, one of which has a fine point for adding or withdrawing small portions of butter in the final adjustment.

In windy weather it is necessary to close the glass door of the balance case for the final adjustment.

This is necessary again when weighing after driving off the moisture.

Evaporation of Moisture.

Having weighed 10 grammes of butter, the next step is to drive off the moisture.

The usual factory method is to heat directly over a spirit lamp. Some use a hot plate either electrically heated or heated by means of a spirit lamp. Others use a bath of liquid paraffin. The liquid paraffin should not be much above 280 deg. Fahr.

The difficult point here is to know when all the moisture has been driven off.

It is necessary to watch closely whilst heating in order to notice the stage when the butter froths or rises in the cup. When this frothing subsides, which it does very quickly, the fat will be seen to be boiling. This is the end point, and the butter will have a light-brownish appearance.

If in doubt as to whether all the water has been driven off, a mirror should be placed quickly over the heated cup and removed to see if there is any condensed water adhering.

Cooling.

After driving off the moisture, the cup must on no account be weighed while it is hot or warm.

It Is Absolutely Necessary to Cool.

This may be done by floating the cup for three minutes in a vessel containing cool water. The cup is then wiped dry with a clean dry cloth and then weighed.

Second Weighing.

The same precautions should be observed in this weighing as in the first.

If the above directions are closely followed the operator will have no difficulty in obtaining satisfactory tests throughout the season.

It has been found most satisfactory to have one man set apart for the moisture-testing work. This man should be made responsible for the care of the balance, the taking of the sample, and the keeping of daily records of each churn. It would give him more interest in his work if he was regularly informed of the results of the official analysis.

The old saying that "Too many cooks spoil the broth" is very applicable to those factories where it is anybody's job to carry out the moisture test.

The Quick Method of Determining Moisture Percentage with Chemical Balance.

Make a counterpoise for the aluminium cup with a piece of lead or brass. Place the cup on left-hand pan and counterpoise on the right-hand pan. See that balance swings correctly.

Place 10 grammes weight on right-hand pan, weigh 10 grammes butter into the cup, evaporate, and cool and dry in usual way and place on the pan again. Allow the 10 grammes weight to remain on the right-hand pan, and add small known weights to the pan, holding the aluminium cup until the scales are balanced again. The weight added multiplied by ten gives percentage of water or moisture.

Example:—If 1.43 grammes are added, moisture equals 14.3 per cent.

OVERRUN OF BUTTER.

By F. J. WATSON, Instructor in Dairying.

MANY dairy farmers do not understand fully the term overrun as applied to the manufacture of butter and the payment to butter factory suppliers. The term was applied originally to the difference between the fat content of a quantity of cream as determined by the Babcock test, and the quantity of commercial butter manufactured from such cream. For example, 250 lb. of cream testing 40 per cent. butter-fat contains 100 lb. of fat. When this cream is churned it produces, say, 117½ lb. of commercial butter. Without making allowances for losses during manufacture, it contains 100 lb. fat, 2½ lb. of non-fatty milk solids (curd, salt, ash, &c.), and 15 lb. of water. The non-fatty solids and water in the butter amount to 17½ lb., representing 17½ lb. overrun on the 100 lb. of pure fat, which is the basis of O'Callaghan's Cream and Butter Tables used in butter factories for determining the quantity of butter that will be produced from individual cream supplies.

The term overrun as now applied to factory operations infers the difference between the yield of butter estimated from the weight and fat content (Babcock Test method), and the actual quantity of marketable butter obtained by churning. For example, a reading of O'Callaghan's Cream and Butter Tables gives 117½ lb. of commercial butter from 100 lb. fat. If it is found that, in churning, the cream containing the 100 lb. of fat produced 120 lb. of butter, the difference of 2½ lb. represents a manufacturing overrun of 2½ lb., or 2½ per cent.

Causes of So-called Overrun and its Variations.

In O'Callaghan's Tables, allowance of about one per centum has been made for losses in churning, packing, &c., and for evaporation of water before marketing the butter. Variations in overrun based on these tables occur through—

- (a) The use of smaller quantities of salt in the butter manufactured than allowed for in the tables, while a quantity of butter is made which contains no salt.
- (b) The custom in butter factories of weighing cream to the nearest pound and reading butter-fat tests to the nearest 1 per cent. By reading to the lowest figure in either case the overrun may be slightly increased.
- (c) The measuring of cream samples instead of weighing. Owing to the gasses contained in supplies of ill-conditioned cream the measured quantities used in testing are underweight and the test results obtained increase the overrun. This irregularity arises from defects in the condition of the cream delivered at the factory.

The crediting of a high percentage of overrun may appeal to some cream suppliers and be regarded as evidence of efficiency in manufacture. Such an impression is misleading, as a high overrun may be gained by reading the tests unduly low or through irregularities in the recording of the weights of cream supplies.

The operation of butter-making on modern principles confines the overrun within definite limits from 1 to 3 per cent. Excessively high and wide variations in the overrun call for more care and attention in testing, manufacturing, and recording operations.

The producer is entitled to be paid for the full amount of butter delivered, but, if the quantity of the delivery referred to as overrun on factory credit slips varies, such variations do not affect the payment that is due to him.

THE PORK PRODUCER AND CONSUMER.

By L. A. DOWNEY, H.D.A., Instructor in Pig Raising.*

IN Queensland there are over 20,000 farmers directly interested in the production of pigs; many hundreds are employed in the manufacture and distribution of pork products, and the majority of the population take part in this great industry when it reaches the meal table.

To the producer the Pork Products Campaign means the production of the greatest possible amount of pork on the farm and the selling of that pork to the best possible advantage. The consumer's object in the campaign is to get the best quality product at the most reasonable price, and then to make the most economical use of these articles of diet in their preparation for the table.

Most pig-raisers in Queensland are dairy farmers who keep pigs as a sideline, chiefly to use separated milk, whey, and butter-milk profitably; these dairy by-products, together with grain, forage crops, and pasturage, provide a very valuable food for pigs. Most dairy farmers make no special provision for conserving fodder for pigs, but rely almost solely on the milk supply, which, as we all know, varies according to the season. The summer season, under normal conditions, brings a flush of milk which is followed by a rush of prime pork and bacon pigs to the market, and, as is to be expected under present marketing conditions, the heavy supply of pigs is met with reduced prices from the buyers. Later, as the milk supply decreases in the colder weather, which usually means a scarcity of good pasturage for dairy cattle, the supply of prime baconers and porkers diminishes, and up goes the price of pigs accordingly.

Price Fluctuation and Light Pockets.

This frequent fluctuation in the price of pigs tends to make the farmer dissatisfied, as it tends to make his pocket lighter. Also the irregularity of supplies of pigs to the bacon factories and slaughter-houses means heavy overhead charges in transport, manufacture, and distribution, which have to be borne by the industry.

The retail prices of pork products to the consumer also vary, and when prices are high the consumer is likely to discontinue the habit of buying them, and even when the price comes back to its low level the consumer may be slow to realise it and, therefore, because of the seasonal fluctuation of the pig supply, the producer is suffering from every point of view.

Weather vagaries are the main factor causing this undesirable fluctuation of supplies, and the producer has no control over the weather itself, but it is quite apparent that there are means of alleviating these conditions.

The Value of Pasture Management.

Dairy farmers are beginning to realise the value of better pasture management to provide a more continuous supply of good pasture. Subdivision of pastures, their cultivation and fertilization where practicable, rotational grazing, and last, but not least, the conservation of meadow hay, are all receiving the attention of progressive dairy farmers. The result of this improved pasture management will mean a greater and more continuous milk flow. The provision of fodder crops and their conservation in the form of silage or hay must also play an important part in keeping the cows in more continuous production. When this is done the dairy farmer will have a more continuous food supply for his pigs.

Another way of overcoming fluctuation in the supply of milk is to use a protein-rich food, such as meat meal, as a substitute for separated milk. Meat meal is a very much concentrated food, a by-product of the meatworks, and, being sterilised, it is quite safe for stock feeding. When fed to pigs, in conjunction with grain and a little green food or grazing, it will satisfactorily take the place of separated milk in the ration. As only a few ounces of meat meal are required daily for each pig, its use is quite economical when properly understood.

Where lucerne can be grown the pig-raiser has another way of overcoming a seasonal shortage of milk for pig food, as lucerne hay or chaff can be fed to pigs with excellent results; in fact, the regular use of a little of these fodders is always advantageous.

The Grain Grower and Pork Production.

Another class of pig-producer becoming more numerous, now that the price of grain is comparatively low, is the grain-grower who, in recent years, has had to look

* From a radio broadcast from 4QG.

for new avenues for disposal of his product on account of congested grain markets. It is to pork production that many grain-growers are now turning their attention. The pig has been proved a profitable means of disposing of our cheap grain, and when lucerne and meat meal are used in conjunction with maize, wheat, or barley the results are very satisfactory; and, as pork producers of this class are not influenced by the fluctuation of the milk supply, they get a larger proportion of the good pig prices than do their friends the dairying pig-raisers, who sell most of their pigs on heavily supplied markets.

By more careful provision of the food supply, the continuous selection of breeding stock, improvement in pig accommodation, especially by the use of pasture for pigs, and full co-operation in marketing his pigs, the producer will be doing his share in the pork and bacon industry.

The farmer has an extensive business which is becoming more complicated every year, and the importance of education and the study of his job cannot be too greatly emphasised. Agricultural Departments, Agricultural Colleges, junior farmer club organisations, and other bodies are making an effort to educate and so help the primary producer in his fight for a comfortable living on the farm.

Complete Co-operation Needed.

In the pork and bacon industry the manufacturers and distributors have an important task, and in all their work greater co-operation among themselves and with the producers and consumers is essential if the overhead charges on the industry are to be kept at a minimum. Everybody concerned in production, manufacture, and distribution wants a fair return for his efforts, but, at the same time, he must not expect the consumer to pay extremely high prices for his products, so the solution of the position lies in increased efficiency from the time the pig is farrowed on the farm until the time it is, in one form or another, handled over the shop counter to the housewife.

When the consumer realises the superior quality of pork, ham, bacon, and the numerous pork products, he is quite prepared to pay a fair and reasonable price for them. Manufacturers are striving continually to have the quality of their pork products all that can be desired, and all their goods are sold with a guarantee so that the consumer feels quite confident in buying Australian pork products.

Quality of Australian Goods.

"Quality" is the password of our Australian exporters, who, particularly during recent years, have placed on overseas markets pork and pork products which have already gained an excellent reputation, and the export pork trade, although in its infancy as yet, may grow to be an extensive outlet for Australian produce. Its future will be determined largely by the regularity of supplies from our farms.

Housewives will help themselves and help the industry if they ask their storekeepers to supply them with booklets prepared by bacon-curers giving lots of hints and new ideas on the economical culinary use of pork, bacon, hams, and small goods and canned meats.

Pig-raising up to the present has been considered more as a sideline to other branches of primary production than as a specialised business on the farm; but farmers are now beginning to display more interest in the business and, as the export of pork appears to offer an outlet for the Australian product, farmers have less fear of over-supplied local markets, which in the past have to some extent been responsible for the producer not taking a more serious view of the industry. As it expands, producers must study every phase of their job in order to work at the highest possible degree of efficiency and keep their costs of production at a minimum and so obtain the best market results.

FARMYARD MANURE IS BEST.

In the new pamphlet issued by the Royal Agricultural Society concerning agricultural research in 1929, Sir E. J. Russell discusses "Soils and fertilizers," and raises the old controversy as to the respective merit of farmyard manure and artificial fertilizers. The broad results of experiments at Rothamsted are that farmyard manure maintains the fertility of the soil better than any ordinary combination of artificials, leads to less variation in yields from year to year than artificials, and causes less disturbance in quality as the yields increase than would be brought about by defective combinations of artificials. Danish experiments reveal to Sir E. J. Russell that there is rapid loss of fertilizing value when farmyard manure is left lying about on the soil.

CLIMATOLOGICAL TABLE—NOVEMBER, 1931.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.				Atmospheric Pressure, Mean at 9 a.m.				SHADE TEMPERATURE.				RAINFALL.	
				Means.		Extremes.							
				Max.	Min.	Max.	Date.	Min.	Date.	Total.	Wet Days.		
Coastal.	In.	Deg.	Deg.	Deg.	Deg.	Deg.		Deg.		Points.			
Cooktown ..	29.92	87	75	90	24	70		9		358	4		
Herberton ..	..	81	62	90	10	54		21		346	11	
Rockhampton ..	29.95	86	68	93	1, 20	57		22		540	11		
Brisbane ..	30.01	80	64	89	20	58		10, 23		851	15		
Darling Downs.													
Dalby ..	29.98	81	60	87	15, 24, 28	47		22		484	11		
Stanthorpe ..	..	73	53	82	27	38		22		406	15	
Toowoomba ..	..	75	56	83	24	44		4, 21		784	13	
Mid-Interior.													
Georgetown ..	29.87	93	71	100	11	61		11, 21		71	5		
Longreach ..	29.90	92	64	100	11	57		22		220	8		
Mitchell ..	29.95	84	60	95	27	44		22		220	11		
Western.													
Burketown ..	29.88	93	74	99	11	66		22		268	3		
Boulia ..	29.89	95	66	109	7	56		22, 23		38	3		
Thargomindah ..	29.93	88	64	102	7	53		21		141	5		

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF NOVEMBER, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING NOVEMBER, 1931, AND 1930, FOR COMPARISON.

The Young Farmer.

CALF FEEDING.

The Digestive System.

The stomach of ruminants, or cud-chewers, such as the cow, sheep, and goat, is composed of four compartments, the first three really being dilations of the oesophagus or gullet. The fourth compartment is the true stomach where digestion takes place.

Rumen or Paunch.

The function of this organ is to act as a storehouse for food taken in. During rumination or cud-chewing the food is passed from this receptacle up through the groove termed the oesophageal groove. It then passes into the mouth, where it undergoes a further process of mastication.

Reticulum.

After this has taken place it is passed into the second compartment, which is known as the reticulum or honeycomb stomach. The function of this organ is to act as a sifting machine, and it is here that all foreign bodies, such as nails, hairpins, wire, &c., are found.

Omason.

The bolus is next returned to the mouth, when it is again masticated, after which it passes into the third compartment, which is known as the omason or manyplies, this name being given because its mucous membrane is arranged in longitudinal folds.

The function of this organ is to act as a churn and press.

The food is next returned to the mouth and, after further mastication, it is returned to the fourth stomach, which is known as the abomasum or rennet bag.

In this compartment the food is acted upon by the gastric juices, and it is here that the true digestion takes place.

MICROBES OR BACTERIA.

BEFORE proceeding further in the treatment and care of calves, it is advisable to know something of the minute organisms which are termed microbes or bacteria, as these are in many ways responsible for sickness in calves (as well as in human beings), and will explain why it is necessary to be particularly cleanly in all dairy work.

What are Microbes or Bacteria?

These are very small living cells. They are far too small to be seen by the naked eye, and can be seen only by using a microscope. Moulds and yeasts are related to bacteria.

Shapes and Customs.

There are numerous species of these bacteria. They are of many different shapes, while their structure also varies. Some are very resistant to heat and others to cold. Some are injurious to health, while others are not. Just as certain plants will not thrive in a hot country, so certain of these bacteria will not live in certain places under conditions which are not suitable.

As certain plants are poisonous, so are certain bacteria dangerous to health.

If one considers for a moment the different types of plants, the different methods of their reproduction, their different methods of feeding, and the places suitable for their development, one will have some idea of the varieties and customs of these small organisms. The terms "micro-organisms" and "germs" are commonly used in referring to these minute organisms.

Method and Rapidity of Reproduction.

Bacteria grow in numbers very quickly. The usual method is to simply divide into two, so that each cell becomes two; each part lives on and again divides. This process takes only twenty to thirty minutes under favourable conditions, so that each bacterium can produce another in less than half an hour. If this would go on in the same manner for several hours, the following stupendous multiplication would result:—

One bacterium would produce—

After 1 hour	..	4 bacteria
After 2 hours	..	16 bacteria
After 3 hours	..	64 bacteria
After 8 hours	..	65,536 bacteria
After 15 hours	..	1,000 million bacteria

Natural conditions, however, will not allow such an excessive multiplication. Lack of food, antagonism of other organisms, &c., always check this rapid development, but in any case their development is rapid enough to be a serious menace to health and the quality of foodstuffs if action is not taken towards checking it.

Some species reproduce by what may be termed "seeds." These seeds are technically known as "spores" and are very resistant to heat.

Where Found.

Certain species of these bacteria predominate in the soil of cold climates, while others predominate in the tropics. Fertile soils are especially rich in bacteria and often contain 100,000,000 bacteria to 1 gram of soil.

Drainage waters carry bacteria from the soil into wells and rivers. Wind and dust lift them from the ground into the air, so that where dust is plentiful bacteria are numerous.

Usually the air in stables, barns, &c., is highly polluted, especially if dusty folders are used. This fact is of considerable importance in the production of clean milk.

Naturally many of these soil micro-organisms will be found on plants. But even if a young plant is grown in a germ-free environment the bacteria which were attached to the seed multiply rapidly and cover the whole plant with an almost continuous thin, slimy layer of bacteria. The slime produced then prevents their being washed off by rain and helps them to preserve a sufficient amount of moisture even during drought periods.

On the skin of animals numerous micro-organisms are continually deposited from the air, the litter, and the manure. The moisture from perspiration enables them to multiply rapidly. Each grain of dirt removed by grooming contains frequently hundreds of millions of bacteria, so that, by touching the flanks or the udder of a cow, many bacteria will be transported by the hands of the milker into the milk bucket.

The cow should be clipped if possible before she calves, or even after the calf has been removed, all hair being removed from around the udder and portions of the body in front of the udder, which portions should be washed with a solution of phenyle and water 1 oz. phenyle to 2 gallons of water. This facilitates cleaning the animals and assists in the production of clean milk, as the hairs on the udder and under parts of the body harbour dirt and bacteria, which find their way into the milk during the operation of milking.

In the normal course of feeding, many bacteria adapted to higher temperatures establish themselves within the intestinal tract and in the first stomach of cows, where rapid multiplication takes place. Afterwards, in the fourth division of the stomach, when the acid gastric juice is added, they are reduced in numbers, but still later in the last part of the intestinal tract they again multiply rapidly. Not less than 10 to 20 per cent. of the dry matter in manure is made up of living and dead bacteria. In solid manure, up to 18,000,000,000 bacteria per grain have been found. Fresh urine, on the other hand, contains practically no bacteria, but it soon becomes strongly contaminated on the ground.

Milk produced in the udder is at first free of these germs, but the small droplets of milk left from each milking enable the bacteria to get into the teat ducts and even into the udder. Large numbers and various kinds of bacteria fall into the milk with falling dirt. This is the main source of contamination of milk, apart from the bacteria which are naturally in milk buckets and utensils that are not thoroughly sterilised.

It was pointed out previously that just as certain plants are poisonous so are certain bacteria injurious to health and the quality of foodstuffs. But just as other plants are useful for food, &c., so are certain bacteria useful in milk by causing the milk to sour, or, in other words, to develop acidity. These are termed the lactic acid organisms and, when their numbers and specie are limited, serve a useful purpose in the manufacture of butter and cheese.

The dairy farmer, however, should endeavour to prevent all bacteria from entering milk, for nowadays people desire butter made from sweet cream, while cheese-makers can secure pure cultures of the bacteria, required to ripen milk for cheese-making, from the Government Bacteriologist in Brisbane.

The lactic acid in milk is formed by the action of these bacteria on the milk sugar.

Slimy orropy milk or cream is formed by certain micro-organisms consuming the sugar of milk and using it to construct large slime capsules around their cells.

General.

Other species of micro-organisms act on the fat of milk, while, generally, micro-organisms are responsible for most of the changes which take place in milk, causing it to deteriorate rapidly in quality.

Pathogenic Bacteria.

There are comparatively only a few species of bacteria which attack animal life with often fatal effect. Such diseases as influenza, typhoid, diphtheria, &c., or anthrax, tuberculosis, blackleg, &c., in cattle are caused by certain bacteria. These bacteria, which affect human beings or other animal life, are termed pathogenic bacteria. Where parts of food (proteins) are decomposed by bacteria, poisons are produced, such as ptomaine; other poisons, usually called "toxins," are produced by the majority of pathogenic bacteria.

These poisons are not always produced immediately in sufficient quantity to affect a person; it sometimes takes several days before sufficient poison has accumulated to produce "sickness."

The blood, when examined under a microscope, will be found to contain red corpuscles and white cells. These white cells are able to devour and to digest pathogenic bacteria. However, this action is not always prompt and speedy, as these cells sometimes seem to be paralysed and unable to attack the bacteria, thus permitting their growth and the production of poisons.

THE BRITISH MARKET FOR PIG PRODUCTS.

"The British market for pig products offers great possibilities for the Empire producer in Britain and overseas. But if the Empire producer is to derive the benefit from the exercise of voluntary preference by the consumer his product must be standardised, suitable in quality, adequate in quantity, regular in supply, competitive in price."

The foregoing is an excerpt from a recent official report from the Imperial Economic Committee in Great Britain, and it opens up an important and far-reaching question in so far as the pig industry here is concerned, for it seems to be evident every year that, unless Australia develops an export trade in pork products, there will be the ever recurring and disastrous fluctuations in prices experienced in recent years, and the constant tendency on the part of one other country to take an Australia as a suitable market for slimmer and possibly more reasonably priced products. The points to which it is desired to draw special attention in the above report are: first, the standardisation of quality in order to attain a permanent inquiry for our products; the necessity for a detailed study of the requirements of the overseas consumer (and there, as here, the tendency is towards lighter weight, more fleshy types); the regularity and efficiency of supplies to build up and permanently hold the trade and production at a price which will enable this country to market her surplus pork products in Great Britain at prices which will compete with those of the English and Irish products, which at present practically monopolise the import trade in pork and bacon.

All these and other points are well worth the closest attention and inquiry, and should form suitable topics for discussion at meetings of local producers, farmers' unions, primary producers' associations and at special conferences on the pig industry. They are all matters to which attention is being given by the Australian Pig Industry Council and State committees, and by similar organisations in each State.

Answers to Correspondents.

BOTANY.

The following answers have been selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.:—

Tie Bush.

INQUIRER (Gympie)—

The specimen is a species of Tie Bush (*Wickstroemia indica*), a plant commonly regarded with suspicion by stockowners, and one accused of poisoning stock on odd times. Some time ago feeding tests with heifers, carried out at the Stock Experiment Station, Yeerongpilly, showed the plant to have little or no feeding value, and to be rather laxative, but not definitely poisonous. After a fortnight's feeding the heifers were in a very weak state, but recovered when put on to an ordinary diet.

Groundsel.

G.R.N. (Maroochydore)—

The specimen is the Groundsel Bush (*Baccharis halimifolia*), a native of South America, that has overrun a good deal of coastal country in Southern Queensland of recent years. It seems to prefer coastal, rather saline flats, but is not confined to such places, as we have seen it on farms in the scrub country of the Blackall Range, Mount Glorious, and other places. It has been thought to poison stock at odd times, but feeding tests with heifers carried out at Yeerongpilly showed the plant, though not to be poisonous, to have practically no nutritive value and to cause constipation.

Caustic Weed.

J.H.W. (Charters Towers)—

The specimen is the Caustic Plant or Caustic Weed (*Euphorbia Drummondii*), a plant very common in Queensland, the sap of which is much used by bushmen for curing cuts, worts, &c., or, in fact, any skin sores. The plant is generally regarded as one poisonous to sheep, particularly hungry, travelling sheep that come on to the plant on an empty stomach. The genus *Euphorbia* is a large one, widely spread over the world, and the species are commonly known as Spurges. Some are known to be poisonous, others are reputed to have medicinal qualities. Owing to the nature of the plants, however, they should always be used with a certain amount of caution. The common Asthma Weed, which is very largely used in Queensland for relief in cases of asthma, is also a species of *Euphorbia*, viz., *E. pilulifera*.

A Milk-tainting Weed (*Rivina laevis*).

C. McG. (Brisbane)—

The specimen collected in the Gympie district was *Rivina laevis*, sometimes known as Stinking Weed, or Stinker, a name, however, applied to other weeds in Queensland. It is a native of Brazil now naturalised in most warm countries, and in Queensland it is generally found along scrub tracks, scrub edges, along fences, &c.; in fact, anywhere where it can get partial shade. It undoubtedly taints milk very badly with a most objectionable taint. On account of the sheltered position in which it grows probably hand picking or hoe chipping will be found the only satisfactory method of eradication.

Star Thistle.

V.C.H. (Daymar, S.W. Line)—

The specimen is *Centaurea melitensis*, the Star Thistle, a native of the Mediterranean region, now a naturalised weed in most warm temperate countries. It is a very bad pest in some of the Southern States, and in New South Wales is most commonly known as Saucy Jack. Stock eat it in its younger stages, but it soon becomes harsh and quite unpalatable. Though comparatively common in some parts of Queensland, it does not seem to be the pest here to the extent it is in the Southern States.

General Notes.

Staff Changes and Appointments.

Mr. H. W. Harvey, Postmaster at Banana, has been appointed an Acting Inspector of Stock.

Mr. D. O. Atherton, B.Sc. (Agr.), Assistant to Entomologist in the Department of Agriculture and Stock, has been transferred from Bowen to Biloela as from the 2nd December, 1931.

New Bird and Animal Sanctuaries.

Executive approval has to-day been given to the issue of an Order in Council under the Animals and Birds Acts declaring the Mount Gravatt Recreation Reserve to be a sanctuary.

Further sanctuaries for the protection of birds and animals have also been declared at Bungaban Station, Wandoan, the property of Mr. John Mundell, and also at Brooklyn Station, Mount Molloy, the property of the Brooklyn Pastoral Company.

It will be an offence for any person to take or kill any animal or bird on the abovementioned properties.

Northern Pig Board.

The Secretary for Agriculture and Stock has appointed Messrs. H. T. Croker (Malanda), J. E. Foxwell (Kureen), D. Johnston (Malanda), H. T. Skennar (Malanda), R. Campbell (Peeramon), and E. Graham (Director of Marketing) to be Members of the Northern Pig Board as from 1st January, 1932, to 31st December, 1932.

Bush Fire Control.

The prolific growth of grass has made the bush-fire risk particularly serious this season, and the need for organised preventive and control measures proportionately urgent. In no way can a rural community co-operate more usefully than in the formation of a well drilled and equipped fire brigade. The following hints on bush-fire fighting, from a paper read by Mr. S. Wilson, Lake Cowal (N.S.W.), before a conference of Riverina and south western farmers, will be of interest to Queenslanders occupying similar country.

Dealing with a fire on large holdings was quite different from dealing with one in a sparsely settled district, said the speaker. In the case of the former it was best to let one make up one's mind, especially in heavily timbered ring-barked country, that a certain area must be lost, and the procedure should be to go ahead of the fire to clear there was a track, plough furrow or grade firebreak, and run a trail along it. The fire cart could be travelling along slowly a few yards behind the man who was lighting, in case of a weak spot, and a second cart, if available, should come along behind, watering out logs before they got too much alight. Palling a second cart, two men, each carrying a bucket of water, and a third with an axe would do wonders. A garden spray pump was also very useful.

Should there be many dead box trees beside the trail, a gang of men should be engaged shovelling the bark and debris for about a foot to eighteen inches away from the foot of each tree, being careful to remove the debris from any roots that were not sufficiently covered by earth. The shovel men must be kept well ahead of the line of fire. A man coming along behind with a bucket of water and a garden rake could save any tree that had been carelessly shovelled round. Should a tree dangerous close to the line catch fire high up, it should be cut down at once, if possible, or all the work would go for nothing.

A few minutes after the grass had been burned, a draught horse or two should be employed pulling the burning logs fully one chain from the edge. If this was done at night, the logs should be heaped together so that they would be quite burned up by next morning. If the logs were too big to pull in and were only burning at one end, they should be cut in two and the burning end pulled away. This was a much safer plan than trying to put them out with water.

When a fire cart was not available and it was desired to make a break through grass, three men should go ahead with garden rakes to make a semi-circle track. This was a quicker procedure than one would think, and as the rakes removed

all little sticks by one fine stroke, also all lying-down dead grass which was easily the hardest; now to extinguish, it would be found a great help. When ploughing a break it should always be endeavoured to have the clean furrow against the fire.

A great difficulty was to get good careful man to hold a fire from breaking out afresh, as all tried to get to the "front" overlooking the fact that a chain was only as strong as its weakest link.

To save sheep that were on a camp which usually would not burn' would require three men, two to hold them while the third lighted a fire around them, though when practicable it was better to muster them into a yard or into any enclosure. Every small holding should have a small bare padlock near the homestead for that purpose.

The commissariat department was of primary importance when fighting bush fires, as men working hard required food often. Plenty of waterbags should be available, and nobody should drink out of fire tanks, as they might have been used for spraying sheep with arsenic, &c.

Influence of Age of Pumpkin Seed on Yield.

Trials to determine the relative values of pumpkin seed of different ages have been carried out at Bathurst Experiment Farm during the past two years. In the 1929-30 trial three-year-old seed gave the best results, while last year, when four, five, and six-year-old seed was tested against 1930 seed, the five and six-year-old seed failed to germinate, while the four year old seed yielded only 7 tons per acre as compared with 9 tons per acre from the 1930 seed, although the four year old seed yielded better quality pumpkins.

Care of Milk and Cream—Prevention of Pollution.

It is a well-established fact—though one not as yet sufficiently recognised by dairymen—that milk and cream are very delicate, that they readily absorb impurities and colours, and that their flavour and keeping qualities are easily spoilt. Serious care must be taken, therefore, to prevent their pollution, not merely by dust, dirt, and flies, and by the minute portions of the stale milk or curd which adhere to vessels unless they are regularly and thoroughly rinsed, scalded, and scour'd bright, but also by the smells and taints given off from dungheaps, dirty balls, and yards, neglected skin receptacles, and sour milk, rubbish, and filth. These should not be allowed to accumulate or remain near places where cows are milked, nor where milk or cream is stored.

The cleaner milk and cream are kept the longer they will keep sweet, and the latter will be the class of butter made from them. Smoking tobacco while engaged in the milking shed or milk room taints the milk, and must not be permitted. Protection from the sun must be provided for cans containing milk or cream in transit by the provision of boards raised 12 inches above the cans on which is laid for this purpose, and the transport vehicle must be maintained in a clean condition. The cans of cream must not be exposed to contamination from animals, manure, or other source.

One at all points is denuded of theairyman's his pocket demands in any so-called *green* nations does the law.—A. and P. Notes, New South Wales Department of Agriculture.

Lime Water for Calves.

Besides being a necessary mineral constituent for all classes of animals, zinc acts also in reducing acidity in the stomach. It also renders the casein portion of milk more readily digestible, particularly by young calves.

Lime water of the requisite strength is easily made on the farm. Take a sack of lime, wash it, and strain it, so that the lime will not be too strong, as water will easily dissolve a quantity of lime in a lime, a grain to the ounce, or 16 grains to the pint. Add a sack of lime, say, 20 lbs., of lime to about 10 gallons of water in a wooden barrel, stir well, and allow to settle. The clear liquid resulting can be used, and water added and stirred until all the soluble portion of the lime has dissolved. The water and lime should be added to the barrel.

Control of Brumbies.

The Governor in Council has approved of the issue of a Proclamation under the *Diseases of Stock Act*, 1915 to 1930, "declaring the Longreach and Barcaldine Stock Districts as Districts for the control of 'boundaries' or worthless horses for the period from the 1st December, 1931, to the 31st March, 1932.

The Government and Acts provide, among other things, for the destruction of brumbies on stock holdings in Queensland under certain conditions. The provisions, however, only apply to such portions of the State as are proclaimed by the Governor in Council, and are limited to a period of not more than four months in any year. Destruction of brumbies, therefore, may be carried out in the Longreach and Burdekin stock districts by stockholders at any time during the period stipulated, provided that all the conditions required by the Acts have first been observed.

Stanthorpe Fruit and Vegetable Levy.

Executive approval has been given to the issue of Regulation No. 297 under the Fresh Marketing Organisation Acts, extending the Standard Fresh and Vegetable Levy Regulations for a further twelve months from the 12th December, 1932, to the 19th December, 1932.

The Standard Fruit and Vegetables Levy Regulations empower the Committee or Director of Fresh Marketing to levy a levy on the growers of all fruit and vegetables grown in the districts situated within a radius of 40 miles from Walgett, and carried from any railway station from Walgett to Dalveen, both inclusive, and from Armidale to Fleubœuf, both inclusive.

The levy is on the basis of the quantity of fruit and vegetables grown, and is at the rate of ten pence per ton of any consignment of fruit and vegetables.

Diseases in Stock—Amended Regulation.

The Government has issued a new Regulation under the Stock Exchange and the Securities Act, which makes Regulation 27 made under the Acts on the 23rd March, 1916.

Banana Board.

THE JOURNAL APPRECIATED.

A Mossman (N.Q.) farmer writes (18/11/31):—

"The Queensland Agricultural Journal" is one of the finest sources of information and a valuable tool for the farmer, and I cannot understand any farmer being without it. I am having my volumes bound, and later on would like to be able to possess copies of all volumes."

The Home and the Garden.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staff of the Queensland Baby Clinics, dealing with the welfare and care of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable cases of infant mortality.

QUEENSLAND SUMMER.

BABY enjoys the hot weather. There is nothing that pleases him better than to exercise his limbs freely in the most scanty attire, or in nothing at all, unless it is to splash about in a tub of tepid water. He is released from the burden of clothing, which oppressed him in the cold season and cramped his movements.

Hot weather is healthy. The three coolest States of Australia have the highest infantile mortality. Last year Queensland had the lowest. That hot weather is dangerous to infant life is just a foolish delusion.

Of course special care is needed during the hot season in some things. If you overclothe baby he will suffer from prickly heat. This is caused by excessive sweating when the sweat is not allowed to evaporate freely. Dress him in cool singlets, not in heavy woollens. Outside the singlet he should wear only the coolest of airy garments, and these should be taken off when he is indoors. Do not torment him with flannel binders. Prickly heat is worst on his back, because he lies on that, and the perspiration cannot dry off quickly. Let him lie on cool sheets, or, better still, on cool vegetable mats. Turn him over sometimes, when he is asleep, and train him to lie on his side.

He does not now need so much heat-forming food. Give him rather less solid food, rather less sugar and fat (climic emulsion for instance). But he needs more fluid, so let him drink as much boiled water as he likes between his meals. Do not forget that this is necessary also for babies who are on the breast.

Boil the Baby's Milk.

During warm weather all kinds of bacteria grow very rapidly, and so food does not keep, but undergoes changes which makes it unwholesome and sometimes even dangerous. Especially is this true of milk. You know how quickly it goes sour. Unfortunately it changes in other ways which are more harmful than sourness. Therefore, be careful to boil your milk as soon as yet get it; then keep it in a cool place carefully protected from flies. Pasteurised milk delivered in bottles does not need to be boiled. It will keep good for twenty-four hours on ice; but otherwise if you have only one delivery you will need to boil it within twelve hours if it is to be kept till next morning. Should your milk be stale or dirty before it is boiled it will cause loose motions. When good, fresh milk cannot be had you may use dried milk (glaxo or lactogen).

Bowel Trouble.

Loose motions or diarrhoea is common in warm weather and needs careful watchfulness. Should your baby suffer from this, you must at once stop giving him milk or any kind of food except very thin barley water, which may or may not be slightly sweetened. Let him drink as much as he wants; he will be thirsty but not hungry. It may be even necessary to take him off the breast for one or two days. You may also give him one teaspoonful of castor oil to clear out any undigested food. Within twenty-four or forty-eight hours he should be much better, and probably a little hungry. A little breast milk may then be given, or you may then give him whey made with junket tablets, but the whey must first be brought to the boil. If he is over nine months you may also give him some arrowroot, cornflour, or sage boiled with water without milk, or a finger of bread baked hard and crisp. Do not give him milk foods until his motions become natural, and give the milk at first in very small quantity, increasing it gradually.

By this treatment attacks of simple diarrhoea are usually easily cured. But it is very different with diarrhoea caused by infectious bacteria. Of these the most dangerous is dysentery. We told you last month how to guard against this epidemic, which attacks us every year in the early summer during the fly season, not, be it observed, in the hottest time of the year, when the epidemic usually subsides. We hope that our advice will be carefully observed, and that it will save many lives. The cause of the increased sickness and more frequent deaths among our infants during the summer is not the hot weather; it is the prevalence of dysentery and other bowel infections during this season. This infection occurs so frequently because mothers do not know how the dysentery bacilli get into their babies. Babies have died from want of knowledge on the part of their parents. Serulously clean hands and the most careful exclusion of flies from food and feeding vessels and teats are baby's safeguards. Flies and dirt cannot be kept from a dummy. So if you have one, put it in the kitchen fire.

Orchard Notes for February.

THE COASTAL DISTRICTS.

FEBRUARY in coastal Queensland is frequently a wet month, and, as the air is often heavy with moisture and very oppressive, plant growth of all kinds is rampant, and orchards and plantations are apt to get somewhat out of hand, as it is not always possible to keep weed growth in check by means of cultivation. At the same time, the excessive growth provides a large quantity of organic matter which, when it rots, tends to keep up the supply of humus in the soil, so that, although the property looks unkept, the fruit-producing trees and plants are not suffering, and the land is eventually benefited. When the weed growth is excessive and there is a danger of the weeds seedling, it is a good plan to cut down the growth with a fern hook or brush scythe and allow it to remain on the ground and rot, as it will thereby prevent the soil from washing, and when the land is worked by horse power or chipped by hand it will be turned into the soil. This is about the most satisfactory way of dealing with excessive weed growth, especially in banana plantations, many of which are worked entirely by hand.

The main crop of smooth-leaf pineapples will be ready for canning, and great care must be taken to see that the fruit is sent from the plantation to the cannery with the least possible delay and in the best possible condition. The only way in which the canners can build up a reputation for Queensland canned pineapples is for them to turn out nothing but a high-class article. To do this they must have good fruit, fresh, and in the best of condition.

The fruit should be about half-coloured, the flesh yellowish, not white, of good flavour, and the juice high in sugar content. Over-ripe fruit and under-ripe fruit are unfit for canning, as the former has lost its flavour and has become "winey," while the latter is deficient in colour, flavour, and sugar content.

For the 30 or 32 oz. can, fruit of not less than 5 in. in diameter is required, in order that the slices will fit the can; but smaller fruit, that must not be less than 4 in. or, better still, 4½ in. in diameter, and cylindrical, not tapering, can be used for the 20-22 oz. can.

Bananas for shipment to the Southern States should on no account be allowed to become over-ripe before the bunches are cut; at the same time, the individual fruit should be well filled and not partly developed. If the fruit is over-ripe it will not carry well, and is apt to reach its destination in an unsaleable condition.

Citrus orchards require careful attention, as there is frequently a heavy growth of water shoots, especially in trees that have recently been thinned out, and these must be removed. Where there are facilities for cyaniding, this is a good time to carry out the work, as fruit treated now will keep clean and free from scales till it is ready to market. Citrus trees can be planted now where the land has been properly prepared, and it is also a good time to plant most kinds of tropical fruit trees, as they transplant well at this period of the year.

A few late grapes and mangoes will ripen during the month, and, in respect to the latter, it is very important to see that no fly-infested fruit is allowed to lie on the ground but that it is gathered regularly and destroyed. Unless this is done, there is every probability of the early citrus fruits being attacked by flies bred out from the infested mangoes.

Strawberries may be planted towards the end of the month, and, if early ripening fruit is desired, care must be taken to select the first runners from the parent plants, as these will fruit quicker than those formed later. The land for strawberries should be brought into a state of thorough tilth by being well and deeply worked. If available, a good dressing of well-rotted farmyard manure should be given, as well as a complete commercial fertiliser, as strawberries require plenty of food and pay well for extra care and attention.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

THE marketing of later varieties of peaches and plums and of mid-season varieties of apples and pears, as well as of table grapes, will fully occupy the attention of fruitgrowers in the Granite Belt, and the advice given in these notes for the two previous months with regard to handling, grading, packing, and marketing is again emphasised, as it is very bad policy to go to all the trouble of growing fruit and then, when it is ready to market, not to put it up in a way that will attract buyers.

Extra trouble taken with fruit pays every time. Good fruit, evenly graded and honestly packed, will sell when ungraded and badly packed fruit is a drug on the market. Expenses connected with the marketing of fruit are now so high, owing to the increased cost of cases, freight, and selling charges, that it is folly to attempt to market rubbish.

During the early part of the month it will be necessary to keep a careful watch on the crop of late apples in order to see that they are not attacked by codlin moths. If there is the slightest indication of danger, a further spraying with arsenate of lead will be necessary, as the fruit that has previously escaped injury is usually that which suffers the most.

Fruit fly must also be systematically fought wherever and whenever found, and no infested fruit must be allowed to lie about on the ground.

Grapes will be ready for market, and in the case of this fruit the greatest care in handling and packing is necessary. The fruit should never be packed wet, and, if possible, it is an excellent plan to let the stems wilt for a day at least before packing. This tends to tighten the hold of the individual berries on the stem and thus prevent their falling off.

In the western districts winemaking will be in progress. Here again care is necessary, as the better the condition in which the fruit can be brought to the press the better the prospect of producing a high-class wine.

Where necessary and possible citrus trees should be given a good irrigation, as this will carry on the fruit till maturity, provided it is followed up by systematic cultivation so as to retain a sufficient supply of moisture in the soil.

Farm Notes for February.

REFERENCE was made in last month's Notes to the necessity for early preparation of the soil for winter cereals, and to the adoption of a system of thorough cultivation in order to retain moisture in the subsoil for the use of crops intended to be raised during the season. The importance of the subject, and its bearing in relation to prospective crop yields, is made the excuse for this reiteration.

Special attention should be given to increasing the area under lucerne (broadleaf Hunter River) wherever this valuable crop will grow. Its permanent nature warrants the preparation of a thorough tilth and seed bed, and the cleansing of the land, prior to sowing the seed, of all foreign growths likely to interfere with the establishment and progress of the crop. Late in March or early in April is a seasonable period to make the first sowing providing all things are favourable to a good germination of seed.

Dairymen would be well advised to practise the raising of a continuity of fodder crops to meet the natural periods of grass shortage, and to keep up supplies of succulent fodder to maintain their milch cows in a state of production.

Many summer and autumn growing crops can still be planted for fodder and ensilage purposes. February also marks an important period as far as winter fodder crops are concerned, as the first sowings of both skinless and cape barley may be made at the latter end of the month in cool districts. Quick-growing crops of the

former description, suitable for coastal districts and localities where early frosts are not expected, are Soudan grass, Japanese and French millet, white panicum, liberty millet, and similar kinds belonging to the *Setaria* family. Catch crops of Japanese and liberty millet may also be sown early in the month in cooler parts of the State, but the risk of early frosts has to be taken.

Maize and sorghums can still be planted as fodder and ensilage crops in coastal districts. In both coastal and inland areas, where dependence is placed largely on a bulky crop for cutting and feeding to milch cows in May and June, attention should be given to Planters' Friend (so-called Imphee) and to Orange cane. These crops require well-worked and manured land; the practice of broadcasting seed for sowing at this particular season encourages not only a fine stalk but a density of growth which in itself is sufficient to counteract to some extent the effect of frost.

In most agricultural districts where two distinct planting seasons prevail, the present month is an excellent time for putting in potatoes. This crop responds to good treatment, and best results are obtainable on soils which have been previously well prepared. The selection of good "seed" and its treatment against the possible presence of spores of fungoid diseases is imperative. For this purpose a solution of 1 pint of formalin (40 per cent. strength) to 24 gallons of water should be made up, and the potatoes immersed for one hour immediately prior to planting the tubers. Bags and containers of all kinds should also be treated, as an additional precaution. "Irish Blight" has wrought havoc at times in some districts, and can only be checked by adopting preventive measures and spraying the crops soon after the plants appear above the ground. Full particulars on the preparation of suitable mixtures for this purpose are obtainable on application to the Department of Agriculture, Brisbane.

Weeds of all kinds, which started into life under the recent favourable growing conditions, should be kept in check amongst growing crops; otherwise yields are likely to be seriously discounted. The younger the weeds the easier they are to destroy. Maize and other "hoed" crops will benefit by systematic cultivation. Where they are advanced, and the root system well developed, the cultivation should be as shallow as possible consistent with the work of weed destruction.

First sowings may now be made of swede and other field turnips. Drilling is preferable to broadcasting, so as to admit of horse-hoe cultivation between the drills, and the thinning out of the plants to suitable distances to allow for unrestricted development. Turnips respond to the application of superphosphate; 2 cwt. per acre is a fair average quantity to use when applied direct to the drills.

Where pig-raising is practised, land should be well manured and put into good tilth in anticipation of sowing rape, swedes, mangels, field cabbage, and field peas during March, April, and May.

TO NEW SUBSCRIBERS.

New subscribers to the Journal are asked to write their names legibly on their order forms. The best way is to print your surname and full Christian names in block letters, so that there shall be no possibility of mistake.

When names are not written plainly it involves much tedious labour and loss of valuable time in checking electoral rolls, directories, and other references. This should be quite unnecessary.

Some new subscribers write their surname only, and this lack of thought leads often to confusion, especially when there are other subscribers of the same surname in the same district.

Everything possible is done to ensure delivery of the Journal, and new subscribers would help us greatly by observing the simple rule suggested, and thus reduce the risk of error in names and postal addresses to a minimum.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK. MOONRISE.

Date.	January, 1932.		February, 1932.		Jan., 1932.	Feb., 1932.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
1	5.3	6.47	5.26	6.44	11.55	8.m.
2	5.3	6.47	5.27	6.44	...	12.40
3	5.4	6.47	5.28	6.43	12.30	1.36
4	5.4	6.48	5.29	6.42	1.5	2.37
5	5.5	6.48	5.30	6.41	1.53	3.38
6	5.6	6.48	5.31	6.40	2.47	4.38
7	5.6	6.49	5.32	6.40	3.46	5.39
8	5.7	6.49	5.33	6.39	4.49	6.40
9	5.8	6.49	5.33	6.38	5.51	7.33
10	5.9	6.49	5.34	6.37	6.51	8.26
11	5.9	6.49	5.34	6.37	7.51	9.19
12	5.10	6.49	5.35	6.36	8.48	10.10
13	5.11	6.49	5.36	6.35	9.45	11.3
14	5.12	6.48	5.36	6.35	10.35	11.59
15	5.13	6.48	5.37	6.34	11.24	12.55
16	5.14	6.48	5.38	6.34	12.18	1.51
17	5.15	6.48	5.38	6.33	1.3	2.49
18	5.16	6.48	5.39	6.32	2.11	3.45
19	5.17	6.47	5.40	6.32	3.7	4.39
20	5.17	6.47	5.41	6.31	4.5	5.28
21	5.18	6.47	5.42	6.30	5.4	6.9
22	5.19	6.47	5.43	6.29	6.0	6.46
23	5.20	6.47	5.43	6.28	6.51	7.21
24	5.21	6.47	5.44	6.27	7.37	7.55
25	5.21	6.46	5.45	6.26	8.15	8.30
26	5.22	6.46	5.46	6.25	8.50	9.7
27	5.22	6.46	5.46	6.24	9.23	9.47
28	5.23	6.46	5.47	6.23	9.56	10.36
29	5.24	6.45	5.48	6.22	10.30	11.31
30	5.24	6.45	...	...	11.7	...
31	5.25	6.45	...	...	11.49	...

Phases of the Moon, Occultations, &c.

1 Jan.	»	Last Quarter	11 23 a.m.
8 "	●	New Moon	9 29 a.m.
16 "	○	First Quarter	6 55 a.m.
23 "	○	Full Moon	11 44 p.m.
30 "	»	Last Quarter	7 32 p.m.

Perigee, 2nd January, 8.48 p.m.

Apogee, 15th January, 7.6 p.m.

Perigee, 27th January, 7.0 p.m.

On 2nd January the Earth will be in perihelion, that is, in that part of its orbit which is nearest to the Sun, and about three million miles nearer than on 6th July, 1931.

The Moon will be passing from west to east of Mercury on the 6th, at 4 p.m., when it will be so far south as to pass almost exactly overhead at Warwick, about 10 a.m.

The new Moon will pass Mars on the 8th, about four degrees southward, at about 7 p.m., soon after it has set. Four hours later, it will be passing five degrees southward of Saturn. At 9 p.m. on the 10th Venus will be passed at the apparently closer range of two degrees.

On the 11th Mercury will be 23 degrees above the horizon at sunrise, having risen about an hour and a-half earlier.

Mars will be passing from west to east of Saturn about 7 p.m. on the 11th, when both planets will be apparently too close to the Sun to be seen.

Saturn will be on the farthest side of its orbit, beyond the Sun, on the 15th, when the Sun will be passing to the eastward of it, rendering it invisible until towards the end of the month. It comes into view in the east before sunrise.

A favourable occultation of Beta Tauri, the brightest star between the Pleiades and Castor and Pollux, will occur near midnight on the 20th.

The Moon will be passing from west to east of Jupiter on the 24th at 4 a.m. Being nearly full, the nearness of Jupiter (two degrees) will be barely noticeable. Two days later the Moon will be passing Neptune somewhat more closely at 11 a.m., when both are below the western horizon.

Mercury will rise at 3.46 a.m. (1 hour 17 minutes before the Sun) on the 1st; on the 15th it will rise at 3.31 a.m. (1 hour 42 minutes before the Sun).

Venus will set at 7.42 p.m. (1 hour 55 minutes after the Sun) on the 1st; on the 15th it will set at 7.31 p.m. (1 hour 54 minutes after the Sun).

As Mars will set only 32 minutes after the Sun on the 1st, and 18 minutes after it on the 15th, it may be said to have disappeared from the evening sky.

Jupiter will rise at 9.25 p.m. on the 1st, and at 8.26 p.m. on the 15th.

Saturn will set at 7.44 p.m. on the 1st, and almost with the Sun on the 15th.

The Southern Cross will be at position VI. (invisible) at 6 p.m. on the 1st, and at 4 p.m. on the 31st, coming into view at Warwick (about eight degrees further east) about 9 p.m. on the 1st and 7 p.m. on the 31st.

7 Feb.	●	New Moon	12 45 a.m.
15 "	○	First Quarter	4 16 a.m.
22 "	○	Full Moon	12 7 p.m.
29 "	»	Last Quarter	4 3 a.m.

Apogee, 12th February, 3.42 p.m.

Perigee, 24th February, 11.30 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 23 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoa, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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